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THE FUTURE OF INDEPENDENT TELEPHONY.

The convention of representatives of the various independent telephone interests of the United States, which will be held in Detroit on Tuesday next, will mark an epoch in the history of telephony in this country. From information received it is learned that the attendance will be very large, and that nearly every company in the country will be represented.

The independent telephone industry has already reached vast proportions. Its importance is hard to overestimate. There is but one element lacking for the complete success of this great industry, and that is organization and united effort. There is no industry in the whole range of the electric arts possessing a future of such magnitude and importance, provided only the strength of the independent movement is not broken by dissensions between the various parts of the body which will organize at Detroit.

It is needless to refer to the legal situation at present. This is not materially different from what it has been for several years, or for that matter, ever since the advent of the independent companies. The Berliner patent is the only dark spot in the brilliant vista opening before these companies, and those who have studied the subject express the opinion that independent companies have little to fear as the outcome of any infringement suits that may be instituted based on the Berliner patent.

The companies which have been organized throughout the length and breadth of the United States for the conduct of telephone exchange business since the expiration of the Bell patent are not individually strong; collectively, however, they form a surprisingly large total, both of invested capital and intelligent effort. Their combination would be practically irresistible. They have an advantage that almost no other corporations have ever enjoyed, in that they represent to a large extent a popular movement and each stands close to the public and to the municipal authorities of its town of origin. Under the circumstances, if these companies are banded together by some strong bond of union, their strength either in resistance or aggression would be colossal. The opportunity for this union will present itself at Detroit.

The union of these companies must be two-fold in order that they may accomplish their destiny. They must not only form a harmonious and unanimous whole in matters of common interest, but they must also connect themselves together by trunk lines for the proper extension of their long-distance business. Already the exchanges of these companies dot the middle West and Southern States, and in many instances the work of connecting them together is begun. Eevry mile of line that is built from one of these exchanges to another is a strengthening link in the position of the independent companies. Backed as they are with the strength of public opinion, and being able, as they will be when these trunk lines are more largely completed, to give the public a variety of service which will be found of the greatest utility, they occupy a practically impregnable position.

The numerous manufacturers of telephone apparatus should not forget at this juncture that their strength also lies in united action. If the convention accomplishes anything in the way of standardiza-

tion of apparatus, it will have done a great work for the art of telephony. The enormous field for the introduction of these new telephone apparatus has hardly been opened. There is room enough in it for all manufacturers to find abundant business. Any dissension on their part at this time may deal an almost fatal blow to the interests of this business, and would be most regrettable and painful.

The movement which will culminate in the meeting at Detroit practically marks the birth of a new industry. While the independent companies have gotten along very well so far, each in its own field, the organization which will probably result from this meeting will place the independent companies in an entirely new position. Each will find itself part of a whole whose magnitude and importance will continually increase. It does not require prophecy to foresee the time when telephone trunk lines will extend across the country and ramify to every point of importance. This is the result and end for which the convention should work Entrenched as each company is in its own local habitation, the result of a close union would be to form a magnificent co-operative corporation, whose extent would be limited only by the boundaries of the country, and whose importance would be greater than that of any other corporation engaged in the electrical business.

THE THREE-CENT FARE LAW.

The Supreme Court of Indiana has just decided that the three-cent-fare law, operative only in the city of Indianapolis, enacted by the State Legislature last winter, is constitutional. The case upon which this opinion was rendered has become a *cause celebre* and has been the subject of much anxious attention on the part of street railway men in many cities.

It was held by the railway company that the act was unconstitutional because it was special legislation, and also because it invalidated the contracts between the street railway company and the city, and between the street railway company and its bondholders. In an opinion rendered in a lower court by Judge Showalter, these contentions were sustained and the three-cent-fare law was declared unconstitutional on account of its special character. This opinion has been reversed by the Supreme Court of the State, with the result that three cents is now the legal rate of fare in the city of Indianapolis.

This decision is sincerely to be regretted. The street railway has been a shining mark for interference by legislators, city councils, and other State and municipal authorities. Not content with burdening street railways with exorbitant taxation and requiring them, as is the case in many cities, to keep the streets through which they run in repair, the Indiana Legislature has gone further and tampered with the rates of fare. Whatever may be the legal status of the matter, there is no doubt that the morality of such an act is at least questionable. The railway was built and has been operated in good faith on the part of its owners, and their money has been spent in improvements greatly benefiting the citizens of Indianapolis, with the reasonable expectation on the part of the company that it would be thereby enabled to conduct a profitable business. Now the State Legislature steps in and invades the rights of the corporation in a way which would be considered shameful if the owner of the railway were a private individual and not a corporation.

WIRELESS TELEGRAPHY.

In our English letter this week is an account of the description of the Marconi system of telegraphy without wires recently given by Mr. W. H. Preece. It appears that when this remarkable system is simmered down to its essence it is only an old friend under a new name. Apparently Mr. Marconi has discovered a new way of receiving his Hertz wave signals, and this is all. The mystery which surrounded the early labors of this investigator, his foreign name, and the remarkable publications which were made concerning his system in various non-technical journals and magazines, all contributed to arouse much specuation as to what he was doing. It now appears that his results are distinguished from those of his predecessors only by the magnitude of the experimental means at his disposal. Signals have been exchanged through some eight miles of air with great satisfaction, and upon this happy result Mr. Marconi is much to be congratulated. As to his ability to telegraph by means of electric oscillations through mountains and the frame of the earth itself, as has been claimed, it must be confessed that belief will be stronger after satisfactory demonstration.

MOTOR PROTECTING DEVICES.

A trial was recently made in this city of the relative merits of magnetic and fusible circuit-breaking devices for the protection of motors. The test consisted of short-circuiting a motor in the leads to which a magnetic circuit breaker and a fuse of equal capacity were included in series with each other. It was expected that the electromagnetic apparatus would open the circuit before the fuse was blown, but apparently this result was not obtained in any of the tests.

The reason for expecting any such phenomenon were not set forth, and, indeed, it seems hard to assign any possible reason why it should have been expected. If the test was intended to demonstrate the superiority of the circuit breaker over the fuse the question naturally arises, why should fuses be used at all? If it meant only that the circuit breaker were intended to operate at precisely the instant when the current reached the set point, it would follow that a circuit breaker fulfilling these conditions would be a very useless piece of mechanism on an operative motor circuit. Motors nowadays are built to carry overloads of considerable magnitude for short periods. This is absolutely necessary on account of the services required of many of them, and in order to prevent the springing open of the circuit breaker with every increase of load and every time the motor is started. A time-lag seems to be a necessary part of the function of protective devices. The annoyance that would be experienced if circuit breakers were absolutely instantaneous in their action would almost compensate for the advantages to be gained through their use. It therefore seems that the elaborate tests referred to demonstrated precisely nothing. As a matter of fact safety devices of both kinds will continue to be used in connection with each other for the very good and sufficient reason that if one fails to work in any emergency the other will probably operate, and so make assurance doubly sure.

THE FUTURE OF INDEPENDENT TELEPHONY.

In another column is an article on the present status and the future of independent telephone exchanges, by Mr. A. B. Guigon, of Richmond, Va. This gentleman, through his connection with one of the largest independent telephone exchanges in the world, in the capacity of general counsel, is ably fitted to speak with authority upon these matters, and his remarks possess an interest which is peculiarly timely at the present juncture.

A Correction.

In the second part of the article by William Maver, Jr., on "Electric Lighting Subways," the types made Mr. Maver say that the diameter of certain iron pipes was from 2 feet 5 inches to 4 inches. The sentence should read: "Their diameter is from 2 to 4 inches."

The Niagara Power Transmission Line.*

BY J. G. WHITE.

The possibilities of the utilization of the almost infinite power of the mighty cataract has been dreamt of and written about ever since the days when the old French monks first attempted to convert the Indians living in this and more Western regions.

A few days ago the speaker received a letter from Mr. Silas P. Dutcher, formerly Commissioner of Public Works of the State of New York, in which he dwelt on his personal recollections of the predictions as to the useful development of this power which the elder Roebling was wont to make some forty-six years ago, while erecting the first suspension bridge over Niagara River, the successful completion of which did so much toward securing recognition of American engineering ability as belonging to the world's front rank. This letter spoke also of the fondness with which former State Engineer Evershed was accustomed to dwell on the possible development of Niagara's tremendous and untiring energy. A most fitting and enduring tribute to this same engineer (Mr. Evershed) is to be seen in the splendid plant of the Niagara Falls Power Company, some of his fundamental ideas as to its hydraulic development having been adopted by the Cataract Construction Company.

The character of this work, as exemplified in the power house, switchboard and other details of the plant of the Niagara Falls Power Company is such as to deserve the thanks of this association and all others interested in electrical developments, on the ground that such working exhibits of high-grade installations have a tendency to raise the standard of all future work.

The poetic, imaginative and prophetic features of a transmission line from Niagara Falls to Buffalo and more distant points have been thoroughly amplified and beautifully expressed not only by such famous engineers as above mentioned, but more recently by such eminent men in our profession as Dr. Sellers, Mr. S. Dana Green, Mr. T. C. Martin, in his lecture, "Niagara on Tap," as well as by numerous members of the technical and general press.

My first personal knowledge as to the then proposed transmission line between Niagara Falls and Buffalo dates from the autumn of 1894, when the White-Crosby Company was asked to prepare and submit detailed plans, specifications and proposals for its construction. It was then found that the engineers of the Westinghouse and General Electric companies had both recommended the construction of circuits of three wires, adapted to the three-phase system, each wire having an area of about 330,000 circular mils. Beyond this no definite plans had then been determined on. The engineers of the Cataract Construction Company at that time considered it advisable to have the line built entirely of iron poles, and accordingly detailed drawings and specifications were prepared and submitted showing alternative plans. The first included two entirely independent lines of iron poles, not less than forty feet long, weighing something over 2000 pounds each. The second consisted of lines of poles of about the same height, weighing 1000 pounds each, set in pairs and tied together by deep trusses, which served both as braces against the terrific wind storms which sometimes sweep across Lake Erie and as a means of carrying part of the wires. A steel truss fulfilling admirably this double function was designed, which weighed about 600 pounds, the company's right of way being thirty-nine feet wide, and the lines of poles located fifteen feet between centres. Several wooden trusses were designed for the same purpose, but, while better from an electrical standpoint, these were all so clumsy, in comparison to the iron poles that preference was given to the steel truss. Various designs of poles were considered, including several built u pfrom "rolled shapes," final preference being given to plain tubular poles, on account of their ability to withstand equally strains from all directions, their appearance, and the ease with which they can be kept painted.

Numerous designs for cross-arms were also considered, including those made from "rolled shapes," composite arms (part wood and part steel), and those made entirely of cast-iron or of wood. The latter two were preferred on account of the ease with which they could be designed to accommodate either wood or iron pins.

In determining the details for these alternative plans it was assumed that poles would be set in concrete and spaced one hundred feet apart; that each wire would weigh one pound per lineal foot; that the three wires composing each circuit were to be placed at the corners of an equilateral triangle having sides at least three feet long; and that the lateral strength of the line was to be not less than three times the forces produced by wind acting with a pressure at right angles with the direction of the lines equal to thirty pounds per square foot on the projected surface of the poles, arms, insulators and wires, when the latter were covered with a coating of ice one-half inch thick.

As a matter of fact the heat generated by the current passing through the wires, together with the static effect tending to repel all particles of moisture coming in contact with the wires, this effect being quite noticeable on a 10,000-volt line, would combine to prevent the formation of any such coat of ice unless at a time when current was off the line.

Any error thus introduced was on the safe side and consequently not objectionable.

Full proposals, with detailed plans and specifications for the construction above outlined were submitted Oct. 11, 1894, and the amended proposition for carrying out the construction on the same general lines was submitted March 13, 1895. Nothing further developed in the matter until June, 1896, when new proposals were asked for the construction of the line on the assumption that white cedar instead of iron poles would be used throughout. Such proposal was submitted June 13 and accepted some days later.

In working out the details of the line as built, the same general assumed data above given was used.

When the route for the line was finally determined on its length was found to exceed twenty-seven miles instead of being twenty-five miles, as previously assumed, and consequently the area of the wire was increased from 330,000 to 350,000 circular mils. The wire actually erected is composed of nineteen strands, having a combined area of full 350,000 circular mils, and weighs nearly 6,000 pounds per mile.

In designing a transmission line the three most important factors probably are: First, its ability to carry its full load continuously and without interruption; second, cost; third, efficiency.

The first cost of power used to develop current for a transmission line is usually low, wherefore the efficiency of the line is not of primary, although of great, importance.

Those of us familiar with the development of the street railway motor have seen in practice an illustration of the fact that efficiency is not always a controlling factor. There has probably never been in general use another street-railway motor so efficient as the Sprague Number 6; yet a distinct advance was made in sacrificing efficiency to mechanical strength, and in subjecting track joints to what at first appeared to be unnecessary and certainly to be deprecated wear and tear, in order to decrease the interruption to traffic.

First cost within reasonable limits should always be considered secondary to good construction, so that you will probably concur in awarding first place as a factor in problems of this nature to the avoiding of interruptions. This is surely of primary importance in most lighting work, and it is easy to conceive of circumstances where the unexpected shutting off of power might have more serious or possibly more fatal results than could ever arise from sudden deprivations of light. Entering into this problem of sure and continuous operation we have the same two factors entering which usually confront us in connection with any electrical installation, namely, insulation and mechanical strength. In low-tension plants of all kinds the insulation is usually accomplished with ease, and any probable defects are likely to be of minor importance, but on such a line as that under discussion the importance of these two factors is practically equal and they are mutually independent. This has been practically illustrated by the experience afforded by the present line. With units of an ordinary size, a short circuit on a line carrying 10,000 volts, even if through a defective insulator, a wooden cross-arm, and a wooden pole, would make itself manifest at the power station by the opening of a circuit breaker, the blowing of a fuse, or some similar method. With the huge generators which furnish power for the line, the effects are different. Of what importance to a 5000-hp dynamo is the current which will lead down a wooden pole even when wet? Nevertheless this same current is sufficient to char or burn the pin under a defective insulator. During one night last fall, while an attempt was being made to operate the line on temporary insulators, the best obtainable at the time, the ends of no less than five of the large cross-arms used on

*Abstract of a paper read before the Niagara Falls Convention of the National Electric Light Association, June 9, 1897.

this line were burned entirely off; and this, too, without any manifestation having been made at the station that anything unusual had occurred. This naturally raises the questions whether it is possible to procure insulators which can be depended on to maintain the insulation on a circuit carrying 10,000 volts or over, and whether it is not good practice to have fewer poles, and consequently less weak spots in the form of insulators. There are two sides to this question, and both deserve serious consideration in designing any transmission line. Let us assume that poles are set 100 feet apart and allow a sag in wires between supports of twenty inches, or one-sixtieth of the length of the span. We find that the area of the wire in use on this line is 0.267 square inch, and that its tensile strength, even assuming a high value for soft copper, is about 10,000 pounds. Allowing the same deflection, one-sixtieth of the length of the span, this determines the maximum safe distance between poles as 178 feet, allowing a factor of safety of four, and shows that the cables might be expected to break if the span were lengthened to 712 feet, not allowing for wind pressure or extra load due to ice.

Assuming a tensile strength of 8000 pounds per square inch for yellow pine, we find that the large cross-arms used on the line, which are 12 feet long and nearly 5 inches wide by 6 inches high, would support a load of 870 pounds on each end without bracing, and of 360 pounds on each end with the steel angle braces used, and this, too, with a factor of safety of ten, an unnecessary margin when we consider that the arms are specially selected heart long-leaf Georgia pine, Similarly these cross-arms would have the same factor of safety carrying three power cables on each side, with spans 177 feet long, if without braces, and 266 feet long with braces. Besides giving this added strength the braces used on this line prevent such vibration and oscillation as usually takes place with the ordinary strap iron braces, such oscillation being the cause of many of the petty troubles on ordinary lines. These braces were each made from a single piece of steel angle-bar, 2 x 2 by 2 x ¼ inches, bent to shape and forming when finished a truss 18 inches deep and 5 feet in extreme length, their weight being a little over 20 pounds each. Assuming again that poles are set 100 feet apart, we find that twelve wires with cross-arms, insulators, etc., would present an area to the wind aggregating about 67 square feet, and that consequently each pole would be subjected to a side strain, when the wind pressure was 30 pounds per square foot, of about 2010 pounds. A sound 50-foot cedar pole 8 inches diameter at top and 18 inches diameter at butt, 8 feet being held rigidly in the ground, would be capable of withstanding before breaking a side pressure near its top of only about 4900 pounds, and of only about 3400 pounds when a layer 2 inches thick had decayed around its circumference.

With spans of 100 feet the pole would therefore have a factor of safety of only about 2.5, when new, while the wires would have a factor of safety of about 7 and the cross-arms of about 26. The advantages of having cross-arms amply strong are so evident, and the possible reduction in cost such an insignificant part of any ordinary line carrying much copper, that it would seem foolish to reduce the strength or size of these in order to bring their strength down to correspond with other parts of the line.

It is evident from the above that the weakest point of this line mechanically is the pole, in spite of the fact that final decision was made in favor of placing the poles 75 feet apart on straight and proportionately closer on curved parts of the route. The only reasonably safe and practicable method of decreasing the number of weak spots furnished by the insulators would be to use poles larger than 8-inch tops, or to brace the poles to withstand this wind strain. Fifty-foot poles having tops greater than 8 inches are now hard to find, and although 35-foot poles were used on a part of the company's private right of way, nevertheless many 50-foot and even a few 65-foot poles were required to avoid obstructions and for crossing railroads and highways. The only feasible plan, therefore, would seem to be to brace the poles laterally, which can readily be done if set in pairs, but which would be very difficult to accomplish in a satisfactory manner with a single line. This naturally brings us back to the question: "Are insulators such insurmountably weak links in such a chain, and is it not possible to get insulators which can be depended upon even when supporting wires under a pressure of 10,000 volts?" This can be most satisfactorily answered by again narrating the experience with this line. During the past eight months insulators have been sent to Niagara Falls by four of the works which are among the first six in this country in the production of porcelain for electrical use. Of a sample lot of ten received a few days ago for test from one of these factories, one had broken in transit, eight broke under the strain of electrical pressure varying from 16,000 to 36,000 volts, and the last broke under 40,000 volts strain. This latter would seem to be a minimum safe test limit for any insulator expected to sustain a regular strain of 10,000 volts, and is a test which any mechanically good, well-vitrified insulator of ordinary design will pass. As several previous lots from the same factory showed even poorer results, the manager of that company states that he hopes within a few weeks to be able to furnish insulators which will stand a 40,000-volt test. It is only fair to state that these insulators were of a smaller type than and different in design from those in use in the Niagara line. Several lots of somewhat similar insulators from another factory gave about the same results.

Several thousand insulators of a diameter almost equal to the round type now on the line, but of a design somewhat different in details, were furnished by a third porcelain works. These were all supposed to have been tested, and to have successfully withstood a pressure of 40,000 volts at the factory before shipment. When, however, these were tested at Niagara Falls by Mr. Lincoln, the electrical superintendent of the Cataract Construction Company, it was found that a large majority of them broke down under a 40,000-volt test, illustrating that a dry test such as had previously been made is useless for practical purposes. The method of test used at Niagara Falls was as follows: The insulators were set inverted in a shallow iron pan in lots of about twenty, the bottom of the pan being covered with an inch or two of water containing a little salt. A little of the same brine was poured into the pin hole of each insulator, and into this was thrust a small piece of metal, such as an ordinary iron spike or the small round zinc rod from an ordinary sal ammoniac battery, this being connected to one side of the testing circuit, of which the other side is connected to the pan containing the insulators. After the metal rod had been placed in the brine in the pin hole of an insulator the primary circuit of the testing transformers, specially built for the purpose was closed; and if the insulator was weak, this was quickly manifested by a series of sparks through the punctured porcelain. Experiments made with pure water and with brine showed that there was no difference in the results; but that any weakness was manifested a little more quickly with brine, besides which the salt imparted the characteristic bright sodium color to sparks otherwise almost colorless and difficult to detect.

As it was important that the line should be ready to deliver current by a specified date, the test was reduced on these insulators to 20,000 volts, and all which withstood this pressure was passed for temporary use. These insulators were later replaced by some of those now on the line, all of which successfully passed a 40,000 volt test made as above described.

A lot of the temporary insulators illustrated the old saying that every rule has its exception, for when, after removal from the line, they were tested under 40,000 volts pressure, a solitary insulator from a total of 1150 was able to pass muster.

Of the insulators shipped by the fourth factory, and of the two types now on the line, about twenty-five to forty were usually found to be defective, breaking down under 40,000 volts, this percentage decreasing in the last shipments received. It is, however, worthy of special note that since the last of the temporary insulators were removed from the line, there has not been one minute's suspension of current supply due to defective insulators. During this time, some three or four months, three insulators have been replaced, none of these being of the oval type. Two of these three had been broken while being put in place, and the third was broken by a stone or other missile. In all three cases only the outer petticoat was broken, and the insulator continued to do satisfactory service until such time as it could be replaced without effecting the operation of the line. Apparently, therefore, it has been demonstrated that it is possible to secure insulators which are reliable. That there have been no greater troubles in the past from defective insulators is probably due to the fact that most of the large transmission plants in operation under high voltage up to within a few months have been in the far West, where a climate prevails very different from that natural to this immediate region.

In the above and other experiments with insulators some interesting facts have been developed, and are worthy of note. The insulating strength of porcelain depends almost entirely on the

thoroughness of its vitrification and very little on its thickness, a thin china tea-cup having successfully withstood a pressure of 60,000 volts, while a coarse piece of porcelain two inches thick was readily pierced by 20,000 volts. It is, therefore, practically unnecessary to test electrically any insulator which, when broken, will not pass a good absorption test, using red ink or other similar fluid.

It is quite, if not entirely, impossible to puncture a glass insulator, even an ordinary pony telegraph insulator withstanding any pressure which can be applied, the last being determined by the pressure which will send an arc around the insulator. The objection to using glass insulators in the past has been due to the difficulty in getting a well-annealed and mechanically-strong insulator, of such massive design as is needed for this work, and to the hygroscopic property of glass, which is not shared by porcelain. The first can unquestionably be overcome by care in manufacture. The importance of the second has probably been exaggerated in most calculations made in the past, due to an inadequate appreciation of the static effects of 10,000 volts in warding off snowflakes and drops of rain, and to a less extent of the rapidity with which water falling on such insulators is evaporated by the heat of the current leaking over the surface.

It is consequently reasonable to expect that the use of glass insulators for high voltage lines will greatly increase with improved manufacture. Meantime any lines erected should have the best obtainable porcelain, and every insulator should be subjected to test.

It is natural to ask: "Is the line as built a genuine success? Can it be depended on, and is it effective?" In answering, let me give briefly some of the facts. The line now in operation is over twenty-five miles long, of which the last 4000 feet is underground, the current being carried in lead-covered cables with rubber insulation, these having been drawn into terra cotta duct conduit built specially as part of this line. These cables successfully withstood a test of 40,000 volts, are guaranteed for five years under working pressure up to 25,000 volts, and were punctured during test only by a pressure estimated by Mr. Lincoln as about 80,000 volts. They have given no trouble since current was first turned on the line, November 15 last, except at two joints imperfectly made. Except for the short time needed to repair one of these joints there has not been a single shut-down chargeable to the transmission line itself since the last temporary insulators were removed some three or four months ago. A number of interruptions to service have occurred during that time, due to derricks used on the work now being done on the Erie Canal hitting wires, undermining of poles and conduit by this work, and to allow new lightning arresters to be put in circuit at transformer houses. Except for these extraneous and unusual causes the service has been perfect with the one slight exception above noted. One short interruption early last winter was due to the dead limb of a tree blowing across the wires, illustrating the fact that all trees should be cut down for some considerable distance on both sides of any high-voltage line. The line shows an insulation resistance of some 250,000 to 300,000 ohms on wet and about 1,000,000 ohms on dry days, this being between any one of the three wires and the ground, the insulation therefore varying from 6,000,000 to 25,000,000 ohms per mile of wire.

The actual working efficiency as shown by the wattmeters in the low-tension alternating circuits at Niagara, and the direct-current 500-volt circuit at Buffalo was 79.6 per cent., this being for a considerable period and a fluctuating load. This efficiency included loss in step-up transformers, line, step-down and rotary transformers. It is probable that any decrease in this due to greater line loss with larger load would to a considerable extent at least be offset by increased efficiency of transformers. In view of these figures I hope you will feel warranted in indorsing the opinion that Niagara power is now being satisfactorily delivered in Buffalo.

One of the questions often asked is: Why this entire line was not placed underground. One of the principal reasons was that the line of twelve wires, having a capacity of 20,000 horse-power, would cost, irrespective of right of way, fully a million and a quarter of dollars if underground, and only about one-third of that amount overhead, making a serious difference in interest charge.

Of such total costs about 20 per cent. would cover cost of conduit complete, including manholes, the remaining 80 per cent. being lead-covered cables.

Of the overhead construction cost, slightly over 80 per cent. is bare copper wire, less than 10 per cent. covers poles set in place, and about 3 per cent. covers insulators.

It is probable, therefore, that the depreciation of the lead-covered cables will greatly exceed that of the pole line, the first cost being some thirty times as great, and the depreciation of the bare copper being negligible. Aside from this, experience to date has not demonstrated that the underground line would be more reliable, which alone could justify the increased depreciation and interest charge.

As a final deduction it seems reasonably certain that it is now possible to build either overhead or underground transmission lines, even in regions subject to much cold, damp weather, capable of carrying current at 10,000 volts or higher pressure, which can be operated with efficiency and every assurance of uninterrupted service.

Electric Lighting Subways.—III.

BY WILLIAM MAVER, JR.

METHODS OF THEIR CONSTRUCTION, ETC.

To provide access to the conduits, manholes are built at intervals of from 150 to 300 feet, usually at street corners, and for distribution of current, boxes, commonly known as hand-boxes, flush-boxes, service-boxes, etc., are generally provided at every house line. Quite frequently in the narrow streets of the larger cities the size of the manholes will be circumscribed by the presence of sewers and water and gas mains, but it is good policy to make them of ample capacity, especially of ample depth, as this permits a better disposition of the cables. The manholes in actual practice vary from six to twelve feet in depth and five to eight feet in width. As a rule the walls of the manholes are built of brick upon a foundation of concrete. The form of cover for the manhole varies with the plan adopted for ventilating the subways. Thus if forced ventilation be adopted the covers will practically seal the opening to the manholes. If natural ventilation is selected the manholes may be perforated. Both of these methods are in operation. Usually an outer and an inner cover are employed, as indicated in Fig. 8, which shows a cross-section of the average subway manhole in which closed covers are used. The outer cover sits loosely on a cast-iron head resting on the walls of the manhole. A curved flange runs around the inside of this head at its base, and the inner cover rests on this flange—a rubber gasket being employed to render the cover watertight. The inner cover is held rigidly upon the gasket by a screw bolt, in the manner indicated in the figure. Distribution boxes are constructed practically in the same manner as the manholes, but, of course, upon a much smaller scale, experience having demonstrated that this was necessary to insure proper strength and durability. These boxes average about two feet square.

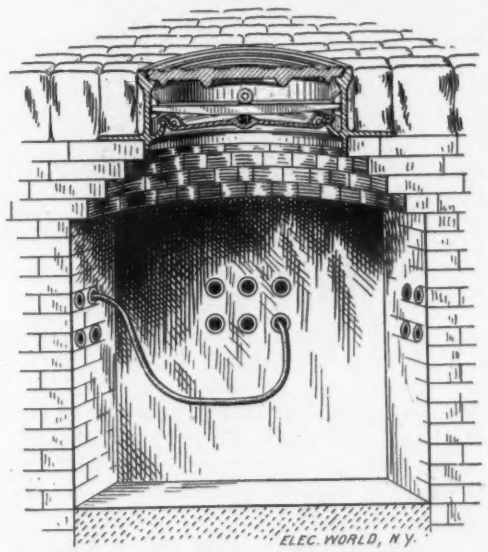


FIG. 8.—CROSS-SECTION OF MANHOLE.

When perforated covers are employed, a drip pan is sometimes placed below the outer cover to intercept dust and street washings; and when the grade will allow it connections are made with adjacent sewers to carry off surface water that may enter the manhole.

The other type of subway for electrical conductors which is

most in use is that known as the solid or "built in" conduit system. In this the conductors are laid in pipes or boxes embedded in some form of insulating material, as, for example, the "Edison" conduit. The main disadvantage of the solid conduit is that in case of necessity for getting at the conductors between manholes or junction boxes it is necessary to dig up the streets. Examples of these conduits were laid in Chicago, Washington and elsewhere ten or twelve years ago, in which the conductors were laid in boxes and embedded in coal tar or asphalt cement, but the practice is not now prevalent. In at least one of these instances of which the writer has information the majority of the wires thus laid have for some time been inoperative. In many parts of Europe single cables, thoroughly armored and juted, and carrying concentric conductors, are laid directly in the earth, but are provided at suitable intervals with accessible junction or service boxes.

The matter of street junction or switch boxes is one which, so far as this country is concerned, has not been very fully developed for electric lighting and power purposes, outside of the Edison conduit system. As a rule no provision is made in the case of high-tension systems for access to conductors in the subways except by cutting into the cables. This condition is, however, measurably due to the fact that the need of changes in many of

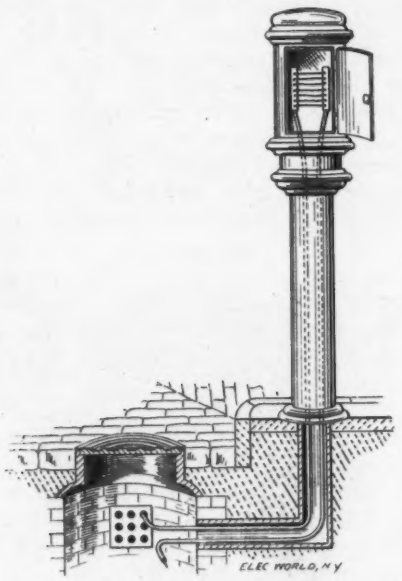


Fig. 9.—Test Box.

the high-tension circuits is so infrequent as not to have warranted the expense of equipping the service with such boxes. Doubtless, however, as the underground system is extended, provision will hereafter be made for such switching arrangements as may become necessary at central points, and this may be in the direction of small sub-stations. It may be noted that in the case of the fire department telegraph service in the New York subways provision is already made for switching and testing wires at various points along the underground subways. This consists of an iron tubular structure about the size of the ordinary fire hydrant, placed on the curb, and into which the cable containing the conductors is looped from an adjacent manhole, as shown in Fig. 9. The terminals of the conductors are attached to binding posts within the head of the post, as indicated, and are joined together by connecting wires. An important advantage of an arrangement of this kind is that it affords access to the conductors for necessary changes and testing, entirely apart from the subways. It may be noted that the difficulty in providing space in manholes for separate switching or junction boxes for the various companies would alone render this plan unfeasible.

In a number of instances small junction boxes, or accessible joints, are at present in use in connection with electric traction underground service. One of these accessible joints, known as the Connor box, is shown in Fig. 10. This is a three-way joint or box. The box is but little larger than the ordinary T-lead sleeve, and the "ways" are wiped to the lead armor of the cable proper in the usual manner. The ends of the cable within the box are joined by suitable metallic connectors, and a removable cover, *C*, is screwed down over the opening shown in the figure. The interior of the box and the cover is lined with sheet rubber to insure proper insulation.

For house to house distribution of current for light and power the service boxes previously alluded to are equipped with side openings from which pipes are led into the adjoining premises;

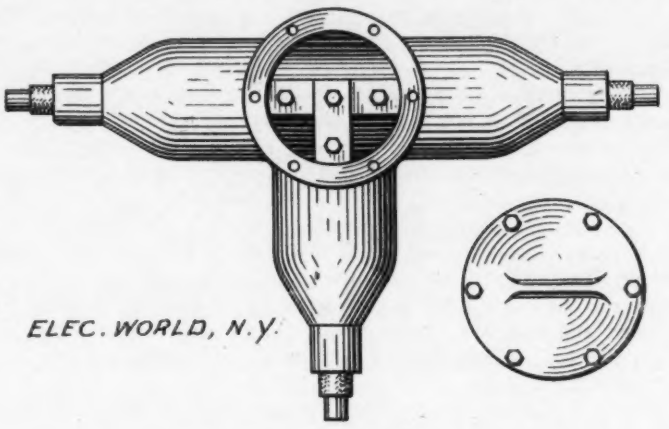


Fig. 10.—The Connor Box.

T or Y joints being made on the main cables in the service box for the service connections, excepting in the case of arc circuits, when the cables are looped in to the buildings. For arc lamps the connections are usually made from the manholes, the iron pipe running up the side of or within the lamp post for some dis-

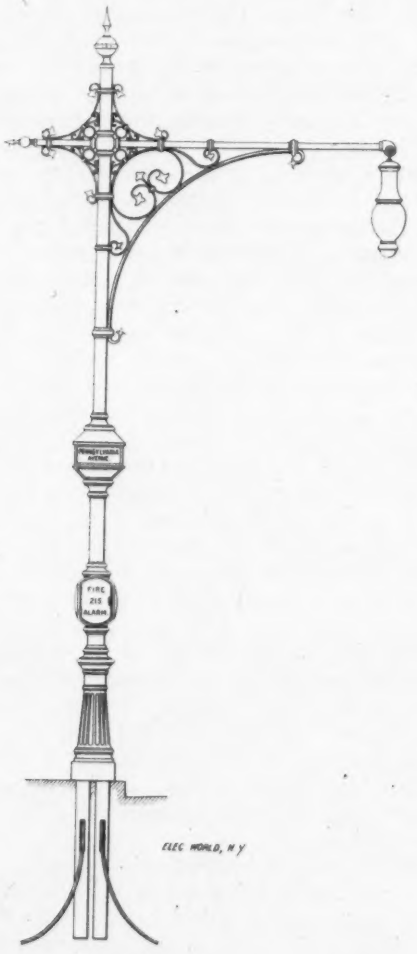


Fig. 11.—Combination Arc Lamp Post.

tance when the cable is brought up to the lamp proper, outside of the post. In a type of combination arc lamp post used in Washington, D. C., by the Potomac Electric Power Company, and shown in Fig. 11, the lamp arm is hollow and is rigidly fastened to the post, the cables being entirely concealed throughout. As no steps are provided on this post the trimmer is provided with a horse and wagon, upon which latter is a suitable step-ladder, by

means of which the lamp is reached. It may be of interest to note that in practice this method has been found to more than double the number of lamps that can be taken care of by one trimmer. As spare lamps and parts of lamps are also carried in the wagon, any needed repairs or changes may be made without delay. Separate pipes may be provided within the post for the cables of the different services, as outlined in the figure.

A somewhat novel form of drawing in conduit is illustrated in Fig. 12. This may be termed a marine electrical subway. It represents a conduit now in operation under the Harlem River, New York City. The conduit consists of four ducts of wrought-iron pipe, jointed in the usual way, and surrounded by planking held together by hoops as shown. The conduit was constructed on the bank of the river, and is shown ready for launching, in

FIG. 12.—SUBMARINE CONDUIT.

Fig. 13. After launching the conduit was sunk to its place on the bottom of the river. No attempt was made to keep the conduit watertight, and the ducts were rodded and the cables were drawn in in the usual manner.

No attempt at a description of electrical subway construction and operation, however brief, would be complete without some reference to methods of ventilation to guard against the dangers due to explosions of gas which is found to accumulate in considerable quantities in the subways in city streets. The first of the methods already referred to, namely, the forced ventilation method, requires the use of fans, or "blowers," at a stated point or points, to provide the necessary air pressure, and additional pipes or tubes connecting with the blowers and passing through the manholes of the subway system. In the practice of this method in New York City, where many miles of subways are thus ventilated, small openings are made in the air pipes in each manhole, through which means an outward pressure is maintained in the manholes, greater than the external inward pressure, the main object being in this case to prevent the ingress of gas into the subways, rather than to keep up a circulation of air through the ducts and manholes. This method has been notably successful in preventing accumulations of gas in the subways thus equipped.

Where the natural ventilation plan only has been adopted, in some cases only perforated covers are employed; in others ventilating pipes are run from the top and bottom of the manholes to the tops of the lamp posts and to the surface of the street. In some localities these natural means of ventilation appear to have been fairly successful; in others not so much so. It is also the case that in certain cities neither forced nor artificial ventilation is employed in drawing in systems of electrical subways.

In the foregoing no allusion has been made to electrical subways consisting of tunnels of sufficient size to allow of the suspension of cables on their walls, for the reason that there are but two or three instances of such tunnels in operation in this country, and these consist of very short sections—not more than 100 or 200 feet in length. It need hardly be remarked that if it were feasible to procure in ordinary city streets a tunnel system of ample capacity, well lighted and ventilated, easy of access, and with necessary facilities for house to house distribution, all at a cost within the purse limits of the "wire users," the ideal subway system would be

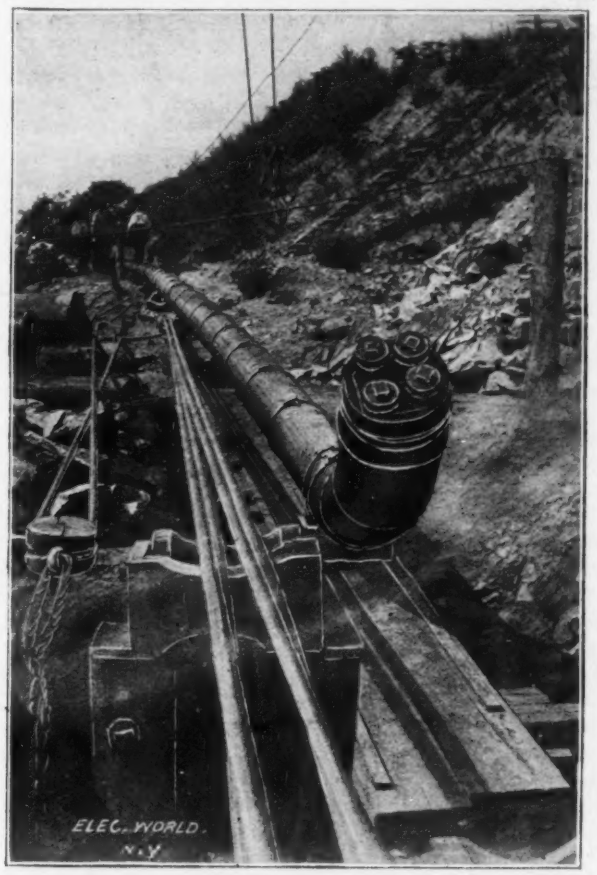


FIG 13.—SUBMARINE CONDUIT READY FOR LAUNCHING.

at hand, inasmuch as this would provide the equivalent of an aerial system without its disadvantages.

Although not within the scope of this article to treat of the cables used in the existing electrical subways, it may be of interest in view of the frequent inquiries as to the present condition of the cables that have been in actual operation for electric lighting purposes for the past eight or nine years, to note that one of these cables, of comparatively thin insulating wall, namely, three thirty-seconds inch rubber, was recently tested and withstood a pressure of 20,000 volts alternating current.

Automobile Cabs in Paris.

On the first of July five hundred automobile cabs will be placed in circulation in the streets of Paris. The Automobile Club de France, which is organizing for April, 1898, a vast exposition of motor-propelled vehicles, seems to have been the impelling force which brought into existence the Compagnie des Petites Voitures. Among the first five hundred cabs that will be put into service will be experimental vehicles built upon nearly every variety of design and upon every system of mechanical traction that has yet appeared, and from the result of their operation the final definite arrangement will be made. It is already estimated that 1500 automobiles are in circulation on the streets of Paris.

New Soldering Material.

According to a German journal a new material is being sold in that country, consisting of a mixture of pulverized tin and rosin; it is used in the form of sticks.

Alternating-Current Machinery.—XI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

IMPEDANCE IN SIMPLE ALTERNATING-CURRENT CIRCUITS.

101. We have hitherto considered the current that is established in a simple alternating-current circuit containing resistance and inductance, under the continuous influence of a sinusoidal E. M. F., and we have seen that the current in such a circuit is sinusoidal. Strictly speaking, however, it is not, as a general rule, sinusoidal the moment the circuit is closed, but only becomes sinusoidal after an appreciable, although usually a very small, interval of time. In other words, the current is not, in general, sinusoidal at the outset, but rapidly approaches to its permanent sinusoidal state.

Thus suppose an alternating-current transformer produces a pressure of 50 volts effective at its secondary terminals under all conditions of load, and that an inductance coil of 1.344 ohms resistance, and 5.592 millihenrys inductance, is connected to the secondary terminals. Then, if the frequency of the circuit be 60 ~ the angular velocity will be 377 radians per second, and the reactance of the coil of frequency is j 2.108 ohms. The impedance of the coil to the currency of this frequency is $Z = 1.344 + j\ 2.108$ ohms $= 2.5\ \underline{/57^\circ\ 29'}$. Consequently the current which will flow through the coil will be $\frac{50}{2.5\ \underline{/57^\circ\ 29'}} = 20\ \underline{\backslash\ 57^\circ\ 29'}$ amperes, or an effective current strength of 20 amperes, lagging behind the pressure by 57° 29′, or nearly one-sixth of a cycle.

But the current will not in general be sinusoidal the moment the circuit is closed, and its initial-wave form will depend upon the instant at which the closure takes place. Thus, in Fig. 63, let the dotted curve *O a b c d E* be the trace of the effective current of 20 amperes (28.28 amperes amplitude), which would flow if the circuit were closed. This curve is a sinusoid retarded 57° 29′ in phase behind the curve of E. M. F., which is omitted from the figure. The curve represents an imaginary current. Now suppose that the circuit is closed at the instant of time represented by *A;* namely, 1/160th of a second later than the time at which the imaginary current crosses the zero line positively at *O*. Then, while the imaginary current will have at this instant the strength *A a* of 20 amperes, the real current has to start at zero. The real current is shown by the curve *A B C D E*, and this practically coincides with the imaginary current after the lapse of about one period, or 1/60th of a second. It will be seen that although the real current is zero at *A*, while the imaginary current has a strength + 20 amperes, yet at *B* the real current is about —32.8 amperes, while the imaginary current is only —28.3. Moreover, the real current attains its maximum slightly in advance of the imaginary current. At *D*, however, the difference between the real and imaginary currents is reduced to about half an ampere, and at *F* the difference is almost imperceptible. The formula which expresses the starting of the current is:

$$I' = I\left\{\sin(\omega t + \alpha) - \epsilon^{-\frac{t}{T}}\ \sin\ \alpha\right\}$$

amperes, where I' is the real current; I, the imaginary current and α the phase angle of the imaginary current at the moment when the circuit is closed, and $t = O$. T is the *time constant* of the coil; that is, the ratio of its inductance to its resistance. This ratio, in the electromagnetic system of units, is a time and is expressed in seconds; so that the time constant of a circuit having an inductance of 1 henry and a resistance of 1 ohm would be one second. The time constant of a circuit is usually only a small fraction of a second, and in the case of the coil considered is only

$$\frac{0.005592}{1.344} = 0.00416 = \frac{1}{240}\ \text{second.}$$

102. The first term in the above formula expresses the permanent sinusoidal current, and the second term expresses the initial deviation. This deviation commences with the value $\sin\alpha$ or the strength of the imaginary current at the instant of closure, and diminishes logarithmically at the rate $1/T$, in this case, 240. The rate of diminution is shown in Fig. 63 at the lower curve. Thus, *a″*, *a′*, the initial deviation, is 20 amperes, or equal to *A a*. At *p″*, 1/480th second later, the deviation has fallen to 12.12 amperes, or in the ratio 0.606. At *q″*, after the lapse of another 1/480th of a second, the deviation has again fallen in the ratio of 0.606, or to 7.36; *i. e.*, $20 \times (0.606)^2$. Similarly, at *b″*, 3/480ths of a second from the outset, the deviation has become $20 \times (0.606)^3$, and so on. By subtracting the ordinates *a″ a′ b″ b′ c″ c′*, etc., on the logarithmic curve from the corresponding ordinates *a*, *b*, *c*, of the imaginary current curve, we obtain the real current curve, *A B C*.

Since the initial value of the deviation is equal to the strength of the current at the moment of closure, the deviation will evidently be a maximum at the crests of the imaginary current waves. On the other hand, the deviation will entirely disappear at the moments when the imaginary current is zero. Consequently the initial disturbance at the closing of a simple alternating-current circuit is greatest if the circuit be closed when the imaginary current is a maximum, and there is no disturbance if the circuit be closed when the imaginary current is zero. This will occur in each cycle at some time later than the instant at which the impressed E. M. F. is zero.

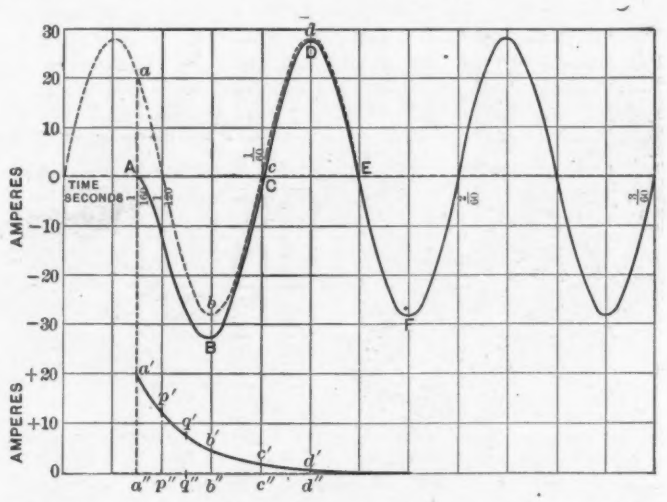


Fig. 63.—Curves Showing the Approach to the Sinusoidal State After Closing a Simple Alternating-Current Circuit.

Consequently, in the case considered, if the circuit were closed about 1/360th of a second after a zero of E. M. F., the current in the circuit would be sinusoidal from the moment of closing, but in all other cases there would be an initial deviation. This deviation does not depend upon the frequency, but only upon the time constant of the circuit considered. In an interval of time equal to the time constant, the deviation always falls to approximately 36.8 per cent., or a little above one-third of its initial value, and after the lapse of five times the time constant, the residual deviation is only about 0.67 per cent. of its initial value. If the frequency of the circuit be high, many cycles may have been executed in this interval of time, whereas if the frequency be low, only a small number of cycles can have been executed. In alternating-current circuits for the distribution of light and power, the current

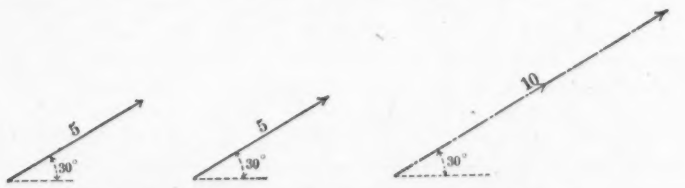


Fig. 64.—Summation of Equiangular Impedances.

will usually have almost attained its permanent state in a single cycle, and the deviation is of comparatively little importance. In circuits linked with iron, such as transformers and choking coils, the presence of iron may considerably modify the conditions which we have here traced. The increase of current amplitude in the particular case of Fig. 63 does not amount to more than about 16 per cent. at *B*, but in coils having closed iron-magnetic circuits the initial current may, in certain cases, attain a much greater range of increase, as will be subsequently considered.

103. Similarly, when a simple alternating E. M. F. is removed from a circuit containing resistance and inductance, the current does not in general immediately cease, but falls to zero logarithmically. Thus, if the E. M. F. impressed upon the coil considered in connection with Fig. 63, suddenly disappeared at the moment when the current was falling, and had reached 20 amperes, as at *A a*, the current would fall to zero, along a logarithmic curve, such as shown at *a′ p′ q′ b′ c′ d′*. This would require, however, that the secondary terminals of the transformer were short-circuited at the instant of time corresponding to *A*, and in practice E. M. Fs. are

almost invariably withdrawn by opening circuits and not by the process of short-circuiting. The conditions which are present when a simple alternating-current circuit is broken are much more complex, tending to the formation of the spark at the contact points, and are beyond the reach of computation at the present time.

104. In a continuous-current circuit, when two resistances are connected in series, their total resistance is the sum of their separate resistances. Similarly, in a simple alternating-current circuit, when two impedances are connected in series, their total impedances is the sum of their separate impedances, and since these impedances are vector quantities, their sum is not an arithmetical, but a geometrical, or vector, sum.

Thus, if two coils are connected in series, and each has an impedance of say $5/30°$ ohms; then, as shown in Fig. 64, their total impedance will be $10/30°$ ohms. If, however, one of the coils, A, has an impedance of $5/30°$ ohms, and the other coil, B, has an impedance of $5/60°$ ohms, their total impedance will be

$$A + B = 5/30° + 5/60° = 9.66/45° \text{ ohms},$$

as shown in Fig. 65. It will be evident from an inspection of Figs. 64 and 63, that the numerical value of the total impedance is the arithmetical sum of the numerical values of the separate impedances only in the case where the angles of the separate impedances are equal. In all other cases the numerical value is less than the arithmetical sum of the numerical values of the separate impedances. Consequently, if a number of impedances are connected in series,

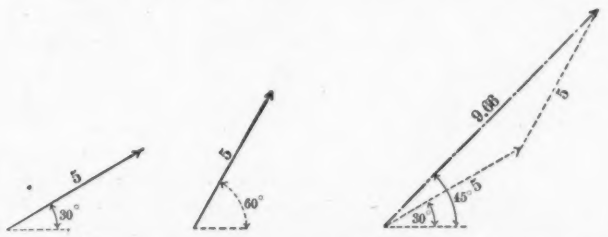


FIG 65.—SUMMATION OF IMPEDANCES HAVING DIFFERENT ANGLES.

the total impedances is usually less than the arithmetical sum of the individual impedances, and the current strength in the circuit, with a given E. M. F., will be correspondingly greater than would be determined by the arithmetical sum of the impedances.

105. In the case of Fig. 65, the difference between the vector sum and the arithmetical sum is only about 3½ per cent., but we shall see that in certain cases the difference may be very great. The summation of impedances is most conveniently effected by the use of complex quantities. The total resistance in a simple alternating-current circuit is the arithmetical sum of the separate resistances, and the total reactance is the arithmetical sum of the separate reactances, so that if $Z_1 = R_1 + j X_1$, $Z_2 = R_2 + j X_2$ and $Z_3 = R_3 + j X_3$ are three separate impedances in series, the total impedance $Z = Z_1 + Z_2 + Z_3 = R_1 + R_2 + R_3 + j (X_1 + X_2 + X_3) = R + j X$.

Consequently, if the separate impedances are expressed as vectors, it is usually convenient to resolve them into their resistance and reactance components, and sum these arithmetically.

Protest Against Delay.

The merchants of Sixth and Eighth Avenues, in New York City, have addressed to the Sinking Fund Commissioners a strong protest against the delay in the equipment of the street railways on those avenues with electricity. The protest, after reciting the troublesome delays, states that "it is intolerable that the people who own property, do business and travel on these streets shall have their interests postponed * * * unless it is absolutely necessary." The memorial then goes on to petition the commissioners to take any steps that may be in their power toward remedying the delay.

Number of Telephone Connections.

According to the *Scientific American*, the American Bell Telephone Company makes an average of 2,630,071 connections per day.

Trunk Line Connections for Independent Telephone Exchanges.

The convention of representatives of independent telephone interests to be held in Detroit next week will have many subjects of deep interest to discuss. None will be of more vital importance than the question of proper methods for the establishment and maintenance of trunk lines between the various exchanges.

With the growth of independent telephone exchanges in many cities and towns throughout the United States the necessity has arisen for their interconnection by suitable trunk line systems, so that the great advantages and benefits of what is popularly termed long-distance telephony can be secured for the subscribers of the various exchanges. The problem that confronts the independent companies in the establishment of such lines is very different from that which obtained when the Bell Company began the construction and operation of the magnificently-equipped link lines which connect its various exchanges in a network covering the whole Northeastern corner of the United States. With it the work was comparatively easy, since the various exchanges, being practically under one management, could be considered as parts of a great whole, and the construction of the communicating lines became merely a question of engineering and finance, comparatively easy of solution. With the new companies the problem is altogether different. Each company is a unit, and a mutual and satisfactory arrangement between the exchanges at the ends of a proposed line is necessary before it is feasible to enter upon the work of construction. There have been several methods used for the construction of these lines. Either a corporation has been formed, consisting of the various telephone companies operating exchanges in separate towns, and this large organization has constructed the connecting links; or lines have been built by separate companies connecting the various points, and a system of toll rates over them inaugurated. In this latter case, it has been the usual custom for the toll line company owning the long-distance line to collect the whole or the greater part of the toll, the local exchanges furnishing their service free for the benefit which inures to them from the possession of long-distance connections. It is hardly necessary to speak of the enormous value and benefit which local exchanges derive from their participation in a general scheme of interconnecting lines. The experience of towns in which long-distance stations have been installed is much the same as that of individual subscribers in an exchange district. It is a fact that when a man of business has once had the benefits of telephone connection he rarely or never dispenses with them. It is equally true of towns and cities that when they have once had practical experience of the value of connecting telephone lines they find it difficult to get along without them. In a certain sense communities, as well as individuals, have to be taught the uses and advantages of telephone service, but this is a lesson which they readily learn and never forget. In certain districts the value of interurban lines has been even greater than was at first anticipated. The facility with which the centres of distribution of certain great crops, for example, tobacco, can be reached, and the hold upon the market for such commodities that is given by the almost instantaneous transmission of intelligence from a large district to a central head, has shown that long-distance lines are a prominent and important factor in these particular varieties of commercial operations. In one case, where long lines radiate from a certain market town, going to nearly every farmhouse through a large and productive district of one of the Eastern States, it has been the daily and habitual custom of farmers and produce raisers along these lines to telephone to the city and consult the market rates before shipping their provisions to the distributing point.

It may be taken for granted that the long-distance connection is of great value to the local exchange. The problem with the majority of independent telephone exchanges is how to get these connections and in what way to go about the organization of interurban service. At the outset they are met with the difficulty that the largest cities, such as New York, Philadelphia and Chicago, are not provided with independent telephone exchanges, and, consequently, cannot be entered by the lines which connect the smaller towns where such exchanges are in operation. While it is true that the bulk of the present long-distance telephone business is conducted between these large centres, there is an enormous volume of business, perhaps not now existent, but which can certainly be cultivated, between the smaller towns, and even from house to house through country districts traversed by such lines. The

whole business of this particular variety of telephony is dependent upon the rates of toll charged for the use of the lines. By bringing this down to a moderate amount the public are encouraged to use the telephone, and soon become dependent upon it in the discharge of many of the functions of their daily business. The question which confronts the owners of independent exchanges desiring such connections is whether it is better to build to the nearest point of some radiating system of link lines themselves, to make some co-operative arrangement with the exchange at the point with which they desire to communicate, or to make arrangements with some entirely independent person or corporation to build lines and maintain them under some system of charges. It is probable that in each individual case the solution of this problem may be different. In general it may be said that the wisest plan seems to be for the telephone companies interested to themselves own and control these connecting lines. If outside persons control the arteries of communication they are in a position to embarrass the service or even to suspend it. With the toll lines owned by the connecting companies the rates may be made whatever seems reasonable and proper, and the business stimulated in a most profitable way. The cost of these lines need not be so great as is generally supposed. For very long-distance work the lines necessarily have to be built in an expensive and thorough manner, and, of necessity, rates of toll for very long-distance conversations are high. Indeed, in some cases these rates are almost prohibitively high, and it is an open question whether or not their reduction would result in a sufficient increase in the volume of business to compensate for the apparent loss thus entailed. The business of the independent telephone exchanges, located as they generally are in small towns and operating what might be called, in distinction, a local long-distance service, would be restricted generally to conversations over comparatively short distances. The battery transmitters in ordinary use by local independent exchanges will work with great satisfaction over well-built lines of No. 10 copper wire to a distance of 200 or 300 miles, and some of them will do even better than this. The cost of a line of this character is a very variable quantity, depending upon the region in which it is constructed and the local cost of poles and labor. It is not generally difficult to secure a right of way for such a line, although in some cases the opposition of the telegraph companies makes itself distinctly felt.

The rates of toll to be charged when such connections are established are usually defined by the amount of business expected and in some degree by the competition of telegraph companies. It is not, however, the general experience that there is any real competition between the telegraph and the telephone for this character of business. The two seem to occupy different places and are used for different purposes. In general, it is probable that a low rate of toll will be found in the long run most profitable, because of its direct encouragement of the use of the telephone.

The beneficial effect of the construction of a general system of interurban lines between independent exchanges can hardly be exaggerated. Each exchange in the general system will be immediately and positively benefited by its ability to give its subscribers communication with the other exchanges, while their legal status will be vastly benefited and improved. The legal status of a telephone exchange has never yet been satisfactorily defined. A franchise for telephone lines is a creation of a municipal body, and these, more than any other forms of legislative assemblies, feel the immediate pressure of public opinion. That telephone company which is closest to the people and which gives them the best service and greatest accommodation, will unquestionably be able to best maintain itself either in competition or against oppressive taxes or the adverse legislation which is occasionally inaugurated by municipalities. Certain legal decisions of late have given rise to the belief that exchanges so connected with other exchanges suddenly acquire new rights, becoming part of the great system of intercommunication which is protected by the laws of the general government, and over which municipal regulations have little effect. The first step to be taken for the realization of a general scheme of interconnection, is mutual action on the part of the telephone companies. When these stand together and weld themselves into a whole by the interconnecting systems their influence and strength will be enormously enhanced. They will become at once potential factors in the business of the districts which they cover, and, as their utility widens, their hold upon the public and upon the towns in which they are located will become stronger and stronger. The stimulus to invention which would result from general extension of these link lines and the consequent great growth of the independent telephone business would unquestionably produce in the course of time new and more improved methods of telephonic communication, the betterment of the service, and a systematic reorganization of the exchanges on a more satisfactory basis. It is probable that before many years a satisfactory telephone repeater will be in general use, and, with the advent of this, long-distance telephony over comparatively inexpensive lines will be an assured fact. The future of independent telephony largely depends upon the extension of these trunk lines. Under the auspices of the present long-distance telephone company the public has been gradually educated to the use of the telephone in many cases where the telegraph was formerly used with less satisfaction. If now this same service can be secured at less rates, there is no question whatever that the volume of business so transacted will increase correspondingly, and that a most profitable source of revenue will be the result.

Three-Cent Fares in Indianapolis.

The Supreme Court of the State of Indiana has recently announced an opinion holding that the law passed by the last Legislature, fixing street railroad fares in the city of Indianapolis at three cents, is constitutional. The opinion, written by Mr. Justice Monks, was concurred in by the full bench.

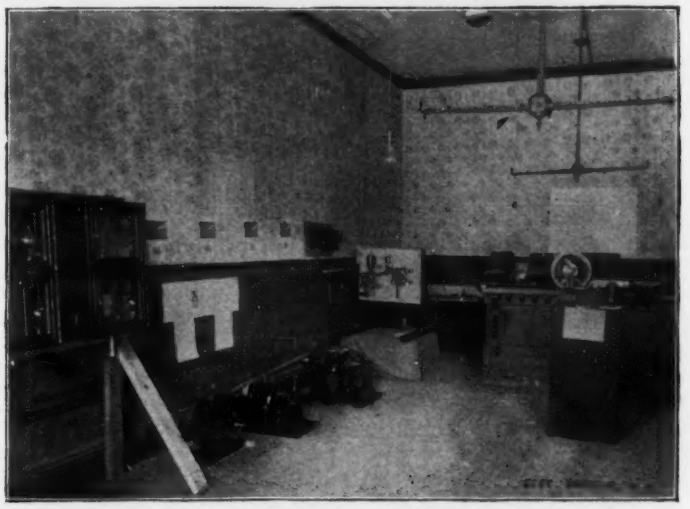
It will be remembered that six weeks ago Judge Showalter, of the United States Circuit Court, then sitting in Indianapolis, held the law to be unconstitutional, and issued an order restraining the officers and employees of the Citizens Street Railroad Company from charging other than a five-cent fare, and also restraining the city and State authorities from enforcing the new law. The case, which has just been decided, was brought by the city of Indianapolis against John N. Navin, the allegation being that he had violated the ordinance fixing the street-car fare at five cents. Mr. Navin was fined $50. He took an appeal to the Circuit Court, and cited the establishment of three cents as the legal fare by the new law. The city nominally resisted the legality of this new law, and alleged, through its attorney, that the law was unconstitutional. The court found for Mr. Navin, declaring the three-cent fare constitutional, and holding that the ordinance fixing five cents as the rate of fare became inoperative when the three-cent law was passed. From this decision the city took an appeal. Another branch of the case was the suit brought by the Central Trust Company of New York for an injunction restraining the Citizens Street Railroad Company from obeying the three-cent fare law, known as the Hugg law, and which enjoined the officials of the city and the State from enforcing it. Judge Showalter, before whom this case came, granted a temporary injunction. In the opinion of the superior court, the constitutionality of the three-cent law is fully upheld. The court held that the city of Indianapolis was not authorized to enter into any contract with the railway company which would prevent the Legislature from making enactments upon the subject of fares. "It is a settled law," the opinion goes on to say, "that the Legislature has the power to reasonably regulate the rates of fare for transportation of passengers within the State on street railways. In order to exempt a common carrier from legislative control over its rates of fare, it must appear that the exemption was made in its charter in clear and unmistakable language, inconsistent with the exercise of such power by the Legislature. The right to regulate the fares of street railways, however, does not include the power to require such companies to carry passengers without reward or for such sum as would amount to confiscation or the taking of property without compensation or due process of law. A statute containing such requirements would be in violation of the provisions of the constitution of the State, as well as of these of the constitution of the United States."

It was further announced by the court that this act of the Legislature, while applying only to the city of Indianapolis, was not special legislation, since it would apply equally to any other city of 100,000 or more inhabitants. It happens that Indianapolis is the only city in the State having such a population; but the act would be equally applicable to any other cities in the State should they increase their population to that amount.

EXHIBIT OF PARAGON FAN MOTORS.

D. & W. FUSES AND HOPE ELECTRICAL APPLIANCE COMPANY'S SPECIALTIES.

PERU ELECTRIC MANUFACTURING COMPANY AND 'ELECTROTHERM' EXHIBITS.



BELKNAP MOTORS. CHAPMAN REGULATORS AND SPECIALTIES. GARTLAND'S REGULATOR.

BUCKEYE LAMPS AND NON-ARCING AUTOMATIC CIRCUIT BREAKERS.

IN THE GENERAL ELECTRIC COMPANY'S ROOMS.

A FEW OF THE EXHIBITS AT THE NIAGARA CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

An English Compliment.

Remarks complimentary to American electrical engineers are so rare in the English journals that the following is worth reprinting. Mr. E. K. Scott, in the London *Electrical Engineer*, in a good article on electric power in workshops, makes the following statement: "It is in the United States and in Switzerland where most work has been done in this line (referring to polyphase-power distribution), and it would almost appear that, thanks to their unequalled water powers and the boldness of their engineers, these two Republics are destined to wrest from us the title of being the workshops of the world."

Independent Telephone Companies—Their Legal Status and Their Prospects for the Future.

BY A. B. GUIGON.

Few decisions rendered by any court of late years have attracted more interest in the commercial world than the recent decision of the Supreme Court of the United States in the Berliner patent case. Indeed, it has created no little excitement and some fear in the minds of uninformed laymen, who in one way or another are connected with the independent telephone companies throughout the country, but these anxieties and these fears, however ill-founded, have been pregnant with good results, even at this early day, as they have caused a renewed interest in various plans for the co-operation and combination of independent companies.

Considering the extent of the impression which first prevailed—that the decision in question would operate to release the Bell Company from all the trammels or restraints which had theretofore prevented a general onslaught against their opponents, it is surprising how soon the calm, dispassionate advice of counsel learned in the law has allayed the fears of the average stockholder and has satisfied him that the recent case of the Government against the Bell Company was but a preliminary skirmish, which has exposed its batteries and the weakness of its position.

First came the assurances of reputable and well-informed journals, headed by The Electrical World, that the Berliner decision was but the Scotch verdict of "not proven," and simply declared that the Government's charges of fraud had not been supported by that measure of proof which would be required to cause the complete annulment and revocation, for the first time in the history of this Government, of a patent once formally granted, and that it was the general consensus of opinion among those competent to decide such matters that the Bell Company would be unable to sustain the validity of the patent itself in infringement suits.

In evident verification of this opinion is the attitude of the officers of the Bell Company since the decision was rendered. Instead of being confronted by the multiplicity of infringement suits which would have followed had the victory been real and tangible, the thousands of independent companies throughout the country, many of whom use instruments which plainly infringe the Berliner patent if it be valid, have gone their way unmolested, and are continuing the establishment and enlargement of their plants. The officials of the Bell Company decline to be interviewed, and seem desirous of creating alarm by the exaggerated air of mystery which they have found so useful in the past.

So general has been the education and enlightenment of the masses upon this matter, which so vitally affects them, that even laymen understand with more or less clearness the fundamental flaws in the United States Berliner patent of 1891, and the application of the Bates & Sulsberger decision to the English patent, in the light of which decision the American patent has ceased to exist by limitation through the expiration of the English patent in January, 1894.

If these views be correct, of which there can be but little doubt, the chief danger to independent telephone companies now lies in the possibility of the absorption or extinction of the weaker and isolated companies by means in which the Bell Company has proven itself an adept, to wit, their harassment by troublesome and costly suits, which they may be too weak to adequately defend, and the immediate result of which may be to weaken public confidence in their enterprise, insidious attacks upon their securities and the cutting of prices and giving of free service—to which last desperate strait so many of the local Bell companies have been already reduced. Armed as the Bell Company is with unlimited resources and with the prestige of complete and exclusive control of the situation for so many years, it would go hard with any single or even a few local companies which should attempt to do business in the field which it claims by pre-emption if it were possible for the Bell Company to concentrate its assaults. But fortunately for the opposition, it is so extensive and indeed so well-nigh universal in this country that the formidable resources, which would be overwhelming if massed, must needs be so dissipated and diverted as to lose their strength and minimize their danger.

From well-nigh every hamlet in the land come reports of new telephone companies organized by local enterprise and with local capital.

Very evidently the American Bell Company has foreseen this condition and has sought to fortify itself against the inroads of opposition through the means of its youngest and most vigorous offspring, the American Telephone & Telegraph Company, by means of whose connecting lines it seeks to force its own local companies down the throats of a protesting public. Wherever the fight is fast and furious and it sees its fortunes wane, behold the emissaries of the Long-Distance Company come demanding a franchise and seeking a foothold by which it may renew and revive the grasp of its local ally.

So it has been in Richmond, Va., under the writer's own observation. At this point, so exasperated had the people become, that they demanded the repeal of the Bell Company's franchise and the establishment of a local telephone plant.

What the people will must ultimately be, so in response to this public demand the rights of the Bell Company were withdrawn by the city government by virtue of a fortunate provision in its franchise, and a local company was established. This has grown far beyond the limits of the old company, whose existence is only prolonged by the pendency of an injunction from the United States Circuit Court temporarily forbidding the city to remove the Bell Company's poles and wires from its streets.

For over a year the American Telephone & Telegraph Company has been demanding a franchise at the hands of the city, and has been endeavoring by the use of every means in its power to gain a foothold in the community. Fortunately for the people, as well as for the opposition company, its efforts have been in vain, and it is well-nigh ready to admit the defeat to which it is doomed.

The people have been willing to forego for the time what little measure of convenience the long-distance service would afford them rather than encourage a branch of that monopoly for whose existence they have so dearly paid.

And then, too, there come reports from every section of the country of the thousands upon thousands of miles of independent connecting lines, which are growing as if by magic, until the people have a right to believe that in the course of a few months or years at the furthest they will have the benefit of the fullest long-distance service.

It is these connecting lines and these local exchanges which propose to combine for their mutual protection and advancement.

The temporary excitement and alarm which the recent Berliner decision created has brought in its immediate train a renewed appreciation of the benefits of combination, and has strengthened and revived a kindly and fraternal feeling among the opponents of the Bell monopoly.

One of the most important meetings in contemplation for conference and organization is that shortly to be held in Detroit, and it is to be hoped that the association to be there perfected will be productive of most far-reaching results, and will serve as a nucleus about which will gather in unbroken ranks the great army of local companies.

How this combination shall be made, and what scope it shall have, are matters of the most vital moment to all concerned.

It would seem in the first place that the most important factor in the success of this work would be the complete self-effacement of each of the companies represented, and the firm determination of every delegate present to put aside, if need be, his own particular views and bend all of his energies to the accomplishment of general results.

However desirable complete unity may utimately be, it cannot be reasonably expected at the outset. Let there be a harmonious confederation of all the interests involved, whose aim and object shall be to watch the general field and perfect by degrees the details of a more compact organization, as circumstances may develop.

While indifference would be most hurtful to the best interests of the opposition, too much must not be expected of the weaker organizations. It can hardly be possible for them to bear their full proportion of the burdens which the impending contest may entail; their more fully developed associates should bear with them in a spirit of patience, and should fully realize that an injury to one, however insignificant, is a menace to all.

In Virginia and the South generally, for example, the independent companies are of recent growth. Their plants are new and in many cases largely experimental, and their energies are devoted to the task of perfecting their enterprises upon a substantial basis, and fulfilling in their local service the expectations of a friendly and confiding public. That these companies will live up to their obligations and extend the sphere of their usefulness, no one at all con-

versant with the situation can doubt. Every company already in operation is meeting with the fullest measure of success, new companies are constantly coming into the field under auspices which give promise of handsome returns, and even at this early day the network of interurban connections is rapidly growing throughout the entire section.

Among the practical results of the co-operative union now forming—by whatever name it may be called—will doubtless be the immediate establishment of a local bureau, composed of a sufficient staff of able attorneys, whose province it shall be to give counsel and assistance wherever it may be needed, and to aid in all legitimate efforts to shape legislation in the direction of fair play and an open field.

The maintenance of such a bureau would be a matter of little difficulty, in view of the magnitude of the interests involved and the concert of action contemplated. It would seem the better policy to leave municipal controversies to local management, but the proposed bureau could give invaluable assistance by the collection and preparation of data and precedents in a convenient form for the enlightenment of city authorities.

Another subject which merits, and will doubtless receive, serious consideration at the Detroit meeting, is the matter of interurban connections and their natural consequence, long-distance lines. It would be wise to entrust the investigation and advancement of this vitally important interest also to a bureau or commission. If composed, as it should be, of men of business and technical capacity and of broad experience in the erection, equipment and operation of such lines, it could render service of inestimable value in the tabulation and arrangement of data upon the subject, to which would be added their friendly counsel and advice to all proposing to undertake such enterprises.

The field is open, the demand unmistakable, but local companies rightly hesitate to increase their undertakings and their responsibilities without the fullest information, and local investors shrink from embarking in what seem to them uncertain and speculative ventures.

This bureau could add greatly to its usefulness by collecting and imparting information in reference to the standing and prospects of the various local exchanges, and could thus facilitate the marketing of their securities upon equitable terms.

Let such a bureau be established and its work available, and ere long every village and every city will have its independent exchange in successful operation, every high road will carry its interurban line, and local and long-distance telephone service at reasonable rates will be an accomplished fact.

The future of the independent telephone is bright—its success is assured. The people have willed it so, and the people's will is law.

The Detroit Convention.

Indications are rapidly coming in, tending to show that the convention of delegates representing the independent telephone interests, which will be held at Detroit, beginning Tuesday, June 22, will be a very large and important gathering. A telegram from Judge James M. Thomas, president of the Executive Committee appointed at the Chicago meeting, says that more than 750 companies had promised to be represented at that date (June 18).

The following letter from Mr. William J. Vesey, secretary of the association, is self-explanatory:

To the Editor of The Electrical World:

SIR—The indications are that the meeting of the independent telephone companies at Detroit on the 22d of this month will be a large and representative one. At least thirty-two States will be represented either by delegations from the State associations or by operators of the telephone exchanges. The temporary Executive Committee, appointed at Chicago, will meet at the Cadillac Hotel in Detroit on Monday, June 21, at 2 o'clock. The general convention will be called the next day at noon.

All the passenger railway associations have agreed upon a rate of one and one-third fare. Full fare is paid going and one-third fare paid on returning, upon the usual certificate plan. It is important that purchasers of tickets secure from the ticket agent from whom they buy their tickets a certificate showing the purchase of the ticket and the amount paid, otherwise no reduction will be made on the return journey. Those expecting to attend the convention not residing near large cities should notify their ticket agents in advance so that they may supply themselves with the proper certificates. The tickets may be purchased and used on Friday preceding the convention and are good returning at any time three days after the convention adjourns.

Respectfully, W. J. VESEY, *Secretary.*

FORT WAYNE, Ind.

An important meeting of telephone men was held in Boston on June 16, for the purpose of selecting delegates to attend the national convention at Detroit.

A large number of representatives were present at the meeting, which was called to order by R. L. Whitman, who was appointed chairman, with N. N. Spofford, manager of the People's Telephone Company, Haverhill, as secretary.

The chairman stated that the object of the meeting was to obtain an expression of the views of the Eastern and Southern interests, and to form a unit which would act in harmony with the Western companies.

Mr. J. D. Leatherbee, treasurer of the National Telephone Manufacturing Company, Boston, at the request of the chair, addressed the assembly, and after briefly referring to the suit of the Bell Company against the National Telephone Company, expressed himself in entire sympathy with the meeting, and hoped it would be successful. Remarks were also made by Mr. N. N. Spofford, W. W. Watts, J. Merrill Lord and E. C. Wilcox.

After a lengthy discussion Messrs. J. D. Leatherbee and S. H. Couch were appointed delegates to attend the Detroit convention and to represent the Eastern interests. A fund was subscribed by those present to defray the expenses of the delegates, and to pay the cost of printing a report of the delegates on their return, to be issued by the chairman, Mr. R. L. Whitman,

Among those present were N. N. Spofford, general manager Peoples Telephone Company, Haverhill, Mass.; J. Merrill Lord, Maine Rural Telephone Company, Limerick, Me.; E. C. Wilcox, Connecticut Telephone & Electric Company, Meriden, Conn.; W. W. Watts, Staunton Mutual Telephone Company, Staunton, Va.; J. V. Westervelt, Malden Telephone Company, Malden, Mass.; J. D. Leatherbee and A. F. Boardman, National Telephone Manufacturing Company, Boston; E. S. Taber, Taber & Mayer, Boston; J. Frank Mixer, of Mixer Bros., Boston; R. L. Whitman and E. S. Couch, of Whitman & Couch, Boston.

The Object of the Telephone Convention.

BY JUDGE JAMES M. THOMAS,
PRESIDENT OF THE INDEPENDENT TELEPHONE ASSOCIATION.

The telephone convention which will meet in Detroit, June 22, 23, and 24, was called for the purpose of completing a permanent organization of the independent telephone interest of the United States.

More than 1200 corporations and individuals were invited to participate. More than three-fourths of the number have expressed their intention of sending representatives. The convention will undoubtedly be a revelation to the people of this country, as very few have any conception of the growth of the independent telephone movement within the past two years. There has been more than $20,000,000 invested in exchanges and toll lines alone since the commencement of this movement.

We find that those who have invested their money have not become frightened on account of the recent decision in the case of the Government against the American Bell Telephone Company. It can truthfully be said that the independent telephone interest is not only willing but anxious to cross swords with the American Bell upon the merits of the Berliner patent. Should the American Bell insist that it has rights under this patent it will find the greatest legal war that it has ever had to contend with, and will certainly meet defeat in every case that is tried. People have not gone into this movement blindly, as is generally supposed. Those who have been responsible for the movement are in possession of evidence that will certainly defeat any action which may be brought. More certain it is that the people are with this movement, and this sentiment alone will make long litigation impossible. More than two years' experience has proven that the telephone business is a good investment at half the prices charged by the Bell Telephone Company, and its lessees. The Detroit meeting will result in a very strong permanent organization, and while the sessions of the convention in most part will be public, the principal business will be conducted in executive sessions of different committees.

Electrical Features of the Railway Master Mechanics' Association.

The American Railway Master Mechanics Association held its thirtieth annual convention at Old Point Comfort, Va., on June 15, 16, and 17. A large attendance attested the interest in the papers and discussions.

As the membership of the association includes superintendents of motive power as well as master mechanics, it had been expected that in view of the recent adoption of the third-rail system by steam roads considerable would be said at this meeting about the important subject now uppermost in the minds of railway managers, the use of electricity on trunk lines. The programme had been prepared some time ago, however, and the only printed paper relating to electricity was the report of the Committee on Motors, Steam, Air and Electric.

This report consisted of a form of inquiry blank, which was sent out to various shops, concerning the use of steam, air and electric motors. Replies were received from twenty-four railroads, which reported the use of thirty-six steam motors, 172 air motors and 229 electric motors. The Baldwin Locomotive Works also reported the use of 220 electric motors in its shops. The committee found a lack of data as to cost. The report contains the statement: "Your committee is decidedly under the impression that both air and electricity are an advantage over steam for portable motors, and also that there are conditions existing where the electric power is preferable for large permanent motors, for driving large tools, and where the convenient operation of an overhead crane is desired."

The president in his annual address referred to the electrical equipment of steam roads, and recommended the appointment of a committee to report on the subject at the next annual meeting.

There were several representatives of electrical companies present. The General Electric was represented by Messrs. S. H. Parker, assistant engineer of the railway department, Schenectady, N. Y., and C. C. Pierce, New England agent, Boston. These gentlemen exhibited a section of the third rail in use on the New Britain-Hartford line. They also distributed a handsome pamphlet concerning the operation of their electric system on that road. The interests of the Walker Company were assiduously looked after by Mr. J. M. McMahan, of the New York office. The missionary work done by these companies at the convention is sure to bear good fruit at the next and subsequent meetings, for the question of electrical equipment is likely to be a live topic at these conventions for several years to come.

Among the exhibits at Old Point Comfort of interest to readers of The Electrical World may be mentioned those of the Adams-Westlake Company, Chicago, represented by Messrs. H. E. Keeler, W. S. Bartholomew and L. A. Gray; the Automatic Lubricator Company, of Rochester, N. Y., exhibited its lubrication methods, and was represented by Mr. John Sherry; Messrs. George Forsyth, F. T. Alden, John Horem, Jr., and J. F. Muldoon, representing the Boston Belting Company, exhibited a line of mechanical rubber supplies; Brown & Sharpe, of Providence, R. I., exhibited a universal milling machine and small tools in operation, under the care of Messrs. C. H. Phillips and S. H. Drury; the J. G. Brill Company, of Philadelphia, represented by Mr. G. L. Haskell, exhibited a very handsome and substantial truck for suburban and interurban service; Mr. W. W. Whitcomb, president of the Composite Brake Shoe Company, of Boston, exhibited his well-known brake shoes with cork insets; the Crosby Steam Gage Company, of Boston, represented by Mr. Edward C. Bates, exhibited a large number of its steam specialties; the Detroit Lubricator Company, of Detroit, represented by Mr. C. B. Hodges and Mr. W. E. Bryant, made a good showing, the Gold Car Heating Company, of New York and Chicago, exhibited a full line of steam and electric heaters, and was represented by Mr. Edward E. Gold, Mr. Egbert H. Gold, Mr. George Sevey, and its electrician, Mr. A. S. Winslow; the H. W. Johns Manufacturing Company, of New York, exhibited a handsome assortment of its asbestos and vulcabeston goods, including a variety of boiler and pipe coverings, packing, etc. The company was represented at the convention by Messrs. F. S. Miller, F. M. Patrick, D. S. Dickson, J. H. Lawson and E. D. Sparks; Jenkins Bros., of New York, exhibited their valves; the Keasbey & Mattison Co., Ambler, Pa., exhibited under the charge of Messrs. George B. Wilson and Wallace W. Johnson their well and favorably known magnesia coverings for boilers, etc.; Messrs. W. H. Shoemaker and W. D. McIlwain represented the Main Belting Company, of Philadelphia, which exhibited belting in sizes from 90 inches wide, down; the Niles Tool Works, of Hamilton, Ohio, exhibited its mild sheet steel pulley; the Peerless Rubber Manufacturing Company, of New York, was represented by Messrs. Brown, Caldwell, C. O. Prosser and W. J. Courtney, and exhibited a variety of rubber goods, among them the "Rainbow" packing. A handsome line of rubber goods was also exhibited by the Revere Rubber Company, of Boston, represented by Messrs. T. F. De Garmo, C. A. Gardner, E. S. Williams and J. C. Jefferson; the Pyle-National Electric Headlight Company, of Chicago, exhibited the Pyle electric headlight for locomotives. This company was ably represented by Mr. Mark H. Ross. The Standard Paint Company, of New York, makers of the P. & B. compounds, had an exhibit under the charge of Mr. F. S. De Ronde; Mr. F. H. Stillman represented Watson & Stillman, of New York, manufacturers of presses, rail benders, punches, etc.; a fine exhibit of these goods was under the charge of Mr. Stillman. The Mason Regulator Company, of Boston, manufacturer of steam pumps and steam-regulating appliances, was represented by Mr. William T. Johnson; Mr. Jacob Wendell, of Wendell & MacDuffie, New York, looked after the interests of the Jerome metallic packing, of which firm is the Eastern representative.

Electric Railways in Ghent.

According to advices received at the State Department, Washington, from United States Consul Morris, at Ghent, the final project for the electric street railways to be constructed in that city is about ready for publication. As several possible American bidders have made inquiries relative to the project a mention of the details so far as known will be of particular interest in this connection. All, however, are only preliminary ,and may be modified. The franchise includes all the lines proposed for the entire city, and will be sold to the highest bidder at a fixed annual rental to be paid to the city for a certain term of years, at the expiration of which the city reserves the privilege of purchasing the entire system. The lines to be operated are numerous and will be planned by the city. The motive power is to be electricity—in the central portion of the city, the accumulator, and in the outlying districts, the trolley system. There will be two separate classes for passengers; the fare in the first class is fixed at 3 cents and in the second class at 2 cents. The working hours of employees are to be 13½ to 14½ hours. The wages of drivers, conductors, and workmen are fixed at 72 1-3, 69½, and 58 cents per day, respectively. Bids were to be received for a period of two months after May 1, last, these dates, however, being only approximate. American manufacturers are held in high esteem in this city, and bids will receive respectful attention.

Roller Bearings.

A party of about 100 engineers and others recently witnessed some tests of roller bearings at Crystal Palace, London, England. According to our London correspondent, two large trucks, each loaded with 5½ tons on the axles, were placed upon level rails on cross sleepers and an apparatus was fitted up for testing the starting resistances by means of a falling weight. The tests showed that a truck with the ordinary bearings to the axles required 22 pounds per ton to start it, whereas the truck provided with roller bearings on the axles required only 3 pounds per ton. It was mentioned that these roller bearings have been used on a considerable number of English railways, including the Liverpool Overhead Railway. Some rollers which have already run 20,000 miles were exhibited, but showed no appreciable heavy wear. It is stated that these roller bearings are also to be fitted to the coaches on the City & South London Railway, where an experimental coach has already been tried for several months and has been found to give great satisfaction.

Bell Telephone Dividend.

The American Bell Telephone Company has just declared its regular quarterly dividend of 3 per cent. and an extra dividend of 1½ per cent., both payable July 15. Since 1895 this company has regularly paid dividends of 15 per cent. per annum. In 1892, it paid 15 per cent.; in 1893, 18 per cent.; and in 1894, 16½ per cent.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamos. MORDEY. Concluded in Lond. *Elec*, June 4; begun in Lond. *Elec. Rev.* and Lond. *Elec. Eng.*, June 4.—The first part of this paper was abstracted in the *Digest* last week. In applying his method to the drum-winding he shows that the study of his system is not so easy, but the main considerations apply equally to both kinds; for drum armatures, however, it resolves itself simply into winding a coil along a chord of the circle instead of along two diametrically opposite parts (in this form it was known and used long ago). An account is given of the results obtained by modifying a toothed drum-wound dynamo on the lines explained; he gives the curves obtained with the machine as received and as modified, showing the relation between the field current and the load; the armature was rewound with a conductor of the same cross-section, but according to his system the complete diagram is given, showing that the winding is more convenient and simple; on being retested the collection was excellent; the excitation at full load was 72.5 per cent. in amperes and 44 per cent. in watts as compared with the old excitation; the variation in volts for a given movement of the brushes was one-fourth of what it was before, and the full load lead, which was originally 67 5 per cent., was now 12.5 per cent.; before the change it could not have been considered a first-class machine, but now it was a very satisfactory one. The winding is actually cheaper and simpler; the coil is shorter, is much easier to put on, and the end connections occupy only half the original end space, while a central space is left clear for ventilating purposes. He then discusses the brushes, collection, and the current flowing in the short-circuited coil; the latter may quite perceptibly increase the armature reaction and may increase the working current to a considerable amount; by checking this current it is possible to considerably reduce the lead angle; the current may even be serious in amount in dynamos which work sparklessly; it is harmful in many ways; to check such currents resistances might be inserted between the commutator and the collector, but they should be gradually introduced; this might be done in the brush by insulating the laminations from each other at the active and uniting them at the other end; applied in a particular case such brushes gave a better collection with only half the lead of the ordinary copper gauze brushes; they were distinctly better than ordinary undivided carbon brushes. Carbon brushes should not be worked with a current density higher than 75 to 100 amperes per sq. in. He discusses the question whether a mechanical pull is exerted directly on or by the conductors of armatures having sunken windings, and describes experiments in which a single wire was mounted so that it would be deflected by forces acting on it; the test was made with an inductor alternator having a stationary slotted armature; the results which are given appear entirely to support the view that the drag on the armature is borne by the teeth and not by the conductors in the slots. Armature excitation is discussed and he shows that the effect with leading brushes is at no load the reverse of what it is at full load. In conclusion, he revives interest in internal field magnet dynamos which were advocated many years ago, as he believes there is now much to be said in their favor; he thinks it unwise to sacrifice too much to retain the convenience of stationary brushes; if machines can be made to work sparklessly with a fixed position of the brushes then the main objections to revolving the field and brushes are removed. The discussion, which is reprinted in full, contains little of interest or importance. Sayers was unable to see that it was possible to get any advantage by adopting Mordey's arrangement; he thought that if he had the whole data of that small machine he could show why the improved results had been obtained; the moment a load was put on the trailing pole was strengthened and the leading pole weakened, and it is the leading pole which does the reversing; he (Sayers) believed it was absolutely impossible to get commutating power from the trailing pole with a continuous winding unless part of the coil was wound in the opposite direction and this would naturally reduce the E. M. F.; he feels confident that Mordey's arrangement will not work with machines of large size; the feature about Sayers' arrangement as far as commutation is concerned is that this is performed by the trailing pole and the commutating power is therefore increased by adding load to the armature; with Mordey's arrangement commutation is with the leading pole and the commutating power is therefore diminished as the load increases, the sparking limit being therefore reached very early; the reversal of the current could therefore not be performed inductively with varying loads and fixed brushes. He did not agree that only 10 per cent. of the exciting power was all that was really essential; for mechanical and other reasons he thought it impossible or undesirable to work with very short air gaps; it leads to an enormous mechanical strain on the armature and bearings; the air gap must be in a definite relation to the width of the top of the slot; closing the top of the slot increases the self-induction to such an extent that he makes his slots as nearly parallel as possible; his arrangement is illustrated; machines with a number of bars per slot were more difficult to commutate than those with only one bar; the back E. M. F. of self-induction is nearly proportional to the square of the number of bars in the same slot which are being commutated at the same instant; he had never found any appreciable eddy currents in buried conductors; he concluded from experiments that there could not be a very strong short-circuiting current in the coils under the brushes in a machine which was not sparking. Gadsby thought that the equivalent of the Mordey winding could be obtained in a simpler way by winding the conductors in a slanting direction on the core or by winding them straight and slanting the pole pieces.

Armature Reaction and the Theory of Commutation. HAWKINS. Lond. *Elec.*, June 4.—A continuation of his long serial. He discusses the cost of motors, width of brushes, the ideal case of sparkless commutation and numerous other subjects. (This paper, is unfortunately, written in such a style that it is difficult to find in it definite and general conclusions for an abstract.)

Equalizing Coil for the Three-Wire System. GIRAULT. *L'Ind. Elec.*, May 25.—After a brief unfavorable discussion of the Elihu Thomson system he gives an illustrated description of the Dobrowolsky system, accompanied by some theoretical deductions. This system, as is now well known, consists in connecting the neutral to the middle point of a reaction coil of great self-induction, the ends of which are connected permanently, through sliding contacts, to two diametrically opposite fixed points of a Gramme winding for a two-pole machine. When the two branches are equally loaded the loss in this coil will be like that in a transformer without load; when the two branches are loaded unequally the return current divides at the middle point into two equal parts, which are then returned to the armature, and there will never be a reversing of the direction of this current in either of the two halves of the coil. His formula shows that the resistance, and therefore the fall of voltage, is a maximum when the diameter connecting the two points of contact is perpendicular to that joining the brushes, and it is a minimum when these two lines coincide; the maximum loss of voltage at the brushes for the two sides is given in a formula, the application of which shows that the loss is less than 1 per cent. of the total voltage, which is confirmed by experience.

Theory of Three-Phase Machines. RITTERSHAUSSEN. *Elek. Zeit.*, May 27.—He discusses the question of the reversing of the polarity mentioned by Rothert (see *Digest*, May 29); he claims that it is due to a property of the machine itself; he prefers exciting the two pairs of magnets in parallel from the outer wires; he does not approve of the reciprocal excitation recommended by Rothert; the objections are all overcome if the four poles are connected in series with each other and a regulating resistance, with another regulating resistance parallel to one pair of them, or when both groups are connected to the outer wires.

Scott System of Transformers. RODET. *L'Ind. Elec.*, May 25.—A short article in which he gives a mathematical explanation of the well-known Scott system for transforming two-phase into three-phase currents. From his investigations he draws the following conclusions: The system does not shift the phase of the primary current of the two transformers with reference to the primary tension, the effective mean of the primary currents of the two transformers is the same for a given power as when the two transformers are operated with the simple alternating current; the generator of the two-phase current operates under the same conditions as though it were feeding the line with a two-phase current of which the two sections are charged the same; of the two currents which pass through the secondary of one of the transformers, the one has its phase advanced by 30 degrees and the second retarded by 30 degrees; to avoid a large magnetic dispersion in the transformer, the two secondary sections should be concentric, or better, be wound in coils which are connected in alternate succession to the two branches; the loss of power in the secondary is greater than 33 per cent. of that which would be produced in that winding if the transformer developed the same power with a simple alternating current.

Rotary Di-Phase Transformer for 100 kw. ALIOTH system. *L'Elec.*, May 29.—An illustrated description, including dimensions and data.

LIGHTS AND LIGHTING.

Guides for Arc Lamp Carbons.—L'Elec., May 22.—A short descriptive article showing a guide on the Naeck and Holsten arc lamp, which is made for very small currents. In arc lamps, especially in those for small currents, troubles arise from the carbons not being exactly in line, especially when they are small in diameter; this guide keeps them centered and is said to operate very satisfactorily. It consists of a horizontal reflecting disc a slight distance above the arc and arranged so that it can readily be moved up and down; it has a hole in the centre through a disc of mica and very slightly larger in diameter than the carbon; some distance below this and attached to it is a thin metallic frame containing a corresponding hole for the lower carbon; the two carbons are thus guided, the arc being always between the two guides.

Loss in Soiled Globes. Hesketh. Lond. *Lightning*, May 27.—He calls attention among other losses to the one due to dirty globes for arc lighting, and to show the amount of this loss he gives the photometric curves for the same lamp before and after cleaning the globe; the mean hemispherical candle power for the dirty globe was 324 and for the clean one 512, which means a loss in the light due to the dirt alone of 36.7 per cent.; he strongly urges those in charge to thoroughly wash the globes periodically with soda, soap and water.

POWER.

Distribution of Power in Workshops. Scott. Lond. *Elec. Eng*, June 4.—A continuation of his long serial. He discusses the question of polyphase motors, giving tabular data for a number of three-phase plants on the Continent; at present there is a disposition to use two-phase currents; there is not much to choose between them, the main difference being in the relative weight of copper required in the lines; as a general rule where lighting is of secondary consideration the three-phase system is preferable, but where lighting and power are used in equal amounts the two-phase system should be used. He gives a brief general description of non-synchronous motors; the cost of the necessary adjuncts for polyphase motors may counterbalance that of the commutator of continuous-current motors; if a good starting torque is required, efficiency and speed regulation must be sacrificed; the series-wound continuous motor has the highest initial torque, amounting to six or seven times the running torque; by sacrificing efficiency and speed regulation the initial torque of polyphase motors may be as high as three times the running torque, and such a motor therefore requires to be of about twice the capacity for a similar starting power, involving a still lower efficiency. The regulating resistances are not so simple; the impedance coil cannot be used, as it increases rather than diminishes the starting current.

Romagnano. Nizzola. *L'Eclairage Elec.*, May 29.—An illustrated description of this water-power installation, which has been in operation for two years and a half, day and night, without interruption; the bi-phase system is used and the total power is 810 horse-power; the frequency is 83.3.

Rheinfelden. Routin. *L'Eclairage Elec.*, May 22.—An illustrated description of portions of this large power plant, which has been referred to frequently in these columns.

Bellegarde. Preller. Lond. *Engineering*, May 28.—The conclusion of this well-illustrated and very complete description of this water-power plant, including large illustrations of the Brown three-phase motor.

New Motive Power. Lond. *Elec. Rev.*, June 4.—An editorial calling attention to a remarkable result claimed by Guattari; he uses a mixture of carbonic-acid gas and ethene chloride, that is, ethylene chloride or Dutch liquid; this is used in the steam boiler in place of water; a saving of 50 per cent. in the fuel is claimed.

Power from Culm.—Elec. Eng., June 9.—An editorial note stating that a genuine project is now under way involving the erection of a steam plant of 20,000 horse-power at Leavenworth, Kansas, in the immediate vicinity of the coal mines; it is contemplated to use engine units of 10,500 and boiler units of 5000 horse-power; the projectors are cautioned that a culm pile may or may not be a gold mine for power transmission.

Springfield, Mass.—Elec. Eng., June 9.—An illustrated description of the Indian Orchard water-power transmission plant which is to replace the existing steam plants; the two-phase system with 133 periods was adopted; the total water-wheel capacity is nearly 2000 horse-power; the transmission is at 5000 volts.

TRACTION.

Jungfrau Railway.—L'Ind. Elec., May 25.—A brief description of this projected mountain railway with a plan and an elevation of the route. Beside the information already given in these columns, the following may be of interest: Each train will have two cars for a total of 70 passengers; the locomotive will be in the rear of the train in ascending; the speed will not exceed 4.8 miles per hour on grades not exceeding 50 degrees; it is thought that at first 1400 horse-power will suffice for three trains ascending and three descending at the same time; 120 horse-power will be required for heating, 258 for lighting the trains, tunnels and stations, and 667 for traction; the total length of the line is 12,800 meters, of which 11,000 is through tunnels. The line will be finished in sections which will be opened as soon as they are finished; it is thought that the whole line will be completed in the year 1901.

Shunt Motors for Traction. Engelhardt. *Elek. Zeit.*, May 20.—A contribution to this discussion (see *Digest*, June 5). The use of such motors is not practicable, aside from all technical considerations, as the reliability will be greatly affected; even an accumulator would not make this a more reliable system than the present. He claims that by using the electric method of braking, the machinery on the car is strained less than with a mechanical brake; this method is used continuously on a car in Berlin where the mechanical brake is used only for final stopping; the method is not only convenient and sure but saves considerable in braking shoes and maintenance of the car machinery; he claims that the electric brake should be used regularly and the mechanical only for emergencies, instead of the reverse, as usual. The issue of May 27 contains an article on this subject by Bauch in which he compares series and shunt motors for traction and in connection with his system of varying the speed of shunt motors (which appears to consist in the use of multipolar fields, the polarities of which are varied), the shunt motor is claimed to become quite practical; energy can then also be restored to the system; even if only 25 per cent. is restored it means a saving, in the illustration which he gives, of 7.5 per cent. in coal.

Accumulator Traction.—Elek. Zeit., May 27.—A note stating that accumulator cars with the Pollak system are being tried experimentally in Frankfort-o.-M.; they are charged on the car at the end station. Another note states that since the 1st of May accumulator traction has been in regular use on a steam railway at Ludwigshafen-on-the-Rhine; the mean speed is 30 miles per hour; no technical information is given.

Roller Bearings.—Lond. *Elec. Rev.*, June 4.—Some figures and illustrations with special reference to their use in traction.

Bonding of the Third Rail. Landis. *Elec. Eng.*, June 9.—An illustrated description of the system used on the N. Y., N. H. and H. R. R.; the description itself is very brief; the third rail is on creosoted pine blocks; the leakage is said to be only 1 per cent., which he explains by saying that "the conductors are so large that there seems to be no incentive for the current to leave them." The bonds appear to be made of copper plates bolted to the rail.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Current; Competition of Private Installations.—Elek. Zeit., May 20.—A reprint of a long discussion of the paper by Kallmann, which was abstracted in the *Digest*, May 15. Pruecker pointed out some errors and discussed some of the conclusions reached by the committee on charging for current; Kallmann replied at considerable length, and gave a mathematical proof that Zickler's curve is a hyperbola. The Lond. *Elec. Rev.*, June 4, gives a translation, in full, of this reference to Zickler's diagram.

Polyphase Distribution. Routin. *L'Eclairage Elec.*, May 29.—A summary of considerations which justified the choice of the polyphase system in the Rheinfelden and the large installation on the Rhone, which were recently described by him.

Gas and Electricity in Germany. Lux. *Zeit. f. Beleucht.*, May 30.—The beginning of an article giving statistics concerning electricity and gas reduced to a common basis; those concerning electricity were taken from the source already noticed in these columns.

Hotel Cecil.—Lond. *Elec. Eng.*, June 4.—A long, illustrated description of this plant, in which Parsons' steam turbines are used; it includes seven typical load curves.

Strassburg. Saint Gilles. *L'Eclairage Elec.*, May 29.—An abstract of a descriptive article from *Genie Civil*, May 1; it is claimed that this is one of the most important and interesting of the three-phase central stations.

Combined Pumping and Lighting. Sykes. *Engineering Journal*, Cal., May.—A short article in which he endeavors to show that a large saving can be secured by combining the pumping and lighting plants for a city into one; after discussing it in a general way he gives the data of an actual case for a small village (name not given) of about a thousand inhabitants; the labor cost was 37.7 per cent. of the total expense; the total expense for the combined plant was $3,500 per year; an estimate for the two systems separately given was $4,540, an additional operating expense of 40 per cent. Another plant for a city of 4,000 inhabitants is briefly referred to, showing a direct saving to the city of $53,100; this plant has furnished light for a lower price than any other plant in a city of like size using coal; the expenses are itemized.

Losses in the Central Station. Herrick. *Elec. Eng.*, June 9.—A double-page colored chart showing, in the form of a diagram, the successive losses in converting the heat units of coal into power and light, through the medium of electrical energy.

Storage Battery in Engineering Practice. Appleton. *Elec. Eng.*, May 26 and June 2 and 9.—A continuation of his very long serial; he enumerates the ways in which batteries can be used to advantage in central stations, giving apparently nothing new; an illustrated description of the Edison plants in Boston and New York are given.

Equipment of a Model Commercial Building.—West. Elec., June 12.—An illustrated description of the plant in the Silversmiths' Building in Chicago, in which electric elevators are also used.

Standard Light and Power Apparatus.—Elec. Eng., June 9.—Under this heading are given a large number of illustrated trade notes describing the products of various companies.

WIRES, WIRING AND CONDUITS.

Rules and Regulations in Switzerland.—L'Elec., May 29.—A reprint, at considerable length, of those prepared by a Swiss commission apparently with the object of making them the standard for that country.

Calculation of Alternating Current Wiring. ALIAMET. *Elek. Anz.*, May 30.—A German translation of the article noticed in the *Digest*, May 22 and June 5.

ELECTRO-PHYSICS AND MAGNETISM.

Influence of the Proximity of Substances on Voltaic Action. GORE. *Phil. Mag.*, June.—A very long paper giving the results of extended experiments to determine whether gravity would produce an electric current; he obtained favorable results showing that gravity by producing pressure exerts an extremely minute influence upon chemical and voltaic action, and that similar effects, though successively minute ones, are produced by the gravitative action of a large mass of metal on the electrode at the end of a horizontal column of the electrolyte.

Influence of the Surrounding Medium on the Conductivity of the Copper. GRIMALDI and PLATANIA. *L'Eclairage Elec.*, May 29.—A brief abstract from the *Jour. de Physique* describing the results of their experiments on the line originally suggested by Sanford; they found that the conductivity of brass in petroleum is 1.00015 times that in air; Sanford obtained the figure 1.0018.

Capacity and Residual Charge of Dielectrics. HOPKINSON and WILSON. Lond. *Elec. Rev.*, June 4.—The beginning of a reprint of a Royal Society paper, a brief abstract of which was noticed in the *Digest*, Feb. 20; they discuss the effects of temperature and time; the present portion is theoretical, giving the laws of the residual charge.

Dielectric Constants at Low Temperatures. ABEGG. *L'Eclairage Elec.*, May 22.—A French translation of the article noticed in the *Digest*, May 22.

Contact Electricity. KELVIN. Lond. *Elec. Eng.*, June 4.—A brief reference to his theory published in *Nature*. It is a molecular theory; he believes that it is the positive and not the negative electricity which is supposed to have no real existence; the atoms of electricity or electrons, are assumed to be small compared with those of ordinary matter.

Thermo-Electric Properties of Liquid Metals. BURNIE. *Phil. Mag.*, June.—A reprint in full of the Physical Society paper which was noticed in the *Digest*, March 20.

Multiple Resonance. L'Ind. Elec., May 25.—A reprint of an Academy paper. As the damping of the exciter is considerable with respect to the resonator, the length of a wave always depends only on the resonator; he endeavored to reverse these conditions in order to make the length of the wave independent of the resonator, and obtained the desired result.

Refraction of Very Short Waves. LAMPA. Lond. *Elec.*, June 4; abstracted from the *Wied. Ann.*, 61, p. 79.—He used waves only 4 mm. in length and measured the refracted indices of a variety of substances by the ordinary prism methods.

Cathode Ray Experiments. G. F. FITZGERALD. Lond. *Elec.*, June 4.—A communication suggesting that Swinton's interesting results (see ELECTRICAL WORLD, April 24, p. 528) are chiefly due to the difficulty of supplying gas molecules sufficiently rapidly to keep the whole surface of the cathode discharging; after the first discharge the supply of fresh molecules would largely take place by diffusion from the edges, the gas in front having been swept away; the discharge might therefore become a hollow curve. He also suggests that some of the penetrative power of cathode rays might be due to the sudden impulses over the restricted area, producing something like a vortex ring which is shot out from the surrounding gas; a wave motion of very short wave length if very intense might be the means of carrying an electric charge forward along with the intense compressions, the compressions and high temperature enabling the charge to be transferred from molecule to molecule.

Crucial Experiments with Röntgen Rays. VOLLER and WALTER. Lond. *Elec.*, June 4; abstracted from the *Wied. Ann.*, 61, p. 88.—They investigated minutely some of the real and alleged properties; they found that when the rays of greatest penetrative power are emitted the production of heat inside of the tube is comparatively small; as exhaustion proceeds the energy previously given out as heat assumes the form of X-rays. They made a large number of experiments to obtain refraction with the diamond and aluminum, but with negative results; they obtained a limiting value, however which is less than one-tenth of Fomm's value; they found that the latter's fringes are probably myths.

Defraction of X-Rays. TIDDENS. Lond. *Elec.*, June 4; abstracted from a Holland paper.—He found that Fomm's fringes do not obey the laws of optical defraction and must be due to some other cause.

Generation of X-Rays. LANGER. *Zeit. f. Elektrochemie*, May 20.—A brief abstract from a German journal. He showed that the property to generate X-rays increases with the molecular weight of the substances from which the rays are propagated, and that therefore uranium salts, especially uranium and green uranium oxide, are better than platinum for the anti-cathode; he made comparisons and found that tubes thus constructed are very much more active and do not require nearly the same care in adjusting the vacuum.

Photographic Action of Röntgen Rays. COLSON. *L'Eclairage Elec.*, May 22.—An abstract of an article describing experiments to find whether the photographic action was a secondary one due to phosphorescence or was direct; he found that the action was direct.

Conduction Produced by Röntgen and Other Rays. BEATTIE and SMOLAN. *Phil. Mag.*, June.—A reprint in full of the long paper, the substance of which was given in papers which have been already noticed (see *Digest*, January 30 and February 6).

Action of an Intense Magnetic Field on Cathode Rays. BIRKELAND. *L'Eclairage Elec.*, May 29.—An abstract of a paper in which he describes experiments similar to those obtained by Fleming and by himself. He also showed that with the prolonged action of a magnet the length of the spark corresponding to a tube can be increased so that any form of Crookes tube may be transformed into an excellent Röntgen ray tube.

Phenomena in Vacuum Tubes. MALTEZOS. *L'Eclairage Elec.*, May 29.—A reprint of an Academy paper describing experiments showing the attraction and bending of cathode rays in a tube.

New Property of Cathode Rays Showing Their Complex Composition. DESLANDRES. *L'Eclairage Elec.*, May 29.—A reprint of the Academy paper an abstract of which was noticed in the *Digest*, June 5.

Explanation of the Experiments of LeBon. BECQUEREL. *L'Eclairage Elec.*, May 22.—A reprint of an Academy paper, in which he shows that the phenomena noticed some time ago by LeBon, and which he attributed to what he called black light, are simply effects produced by the red and infra red rays.

Action of X-Rays on Microbes and on the Heart. SARRAZES and RIVEIERE. *L'Eclairage Elec.*, May 22.—A brief abstract of an Academy paper; they are unable to find any apparent modification in certain microbes when subjected to the action of X-rays; nor could any action be noticed on the heart of a frog by an hour's exposure.

Biological Action of X-Rays. CAPRANICA. *L'Eclairage Elec.*, May 22.—A brief note from the Italian; he showed that X-rays have no influence on organic combustion, the action of the tube being continued four hours per day; no action could be produced on animals inoculated with certain bacteria.

Bacteria and Röntgen Rays. BLAIKIE. Lond. *Elec. Eng.*, June 4.—A brief abstract of a paper giving the results of experiments; he believes to have settled definitely in the negative the question whether Röntgen rays exert any influence on bacteria life, at least as far as the tubercle and diphtheria bacilli are concerned.

Effect of the Form of the Voltage Curve on the Hysteresis Loss in Transformers. FLEISCHMANN. *Elek. Zeit.*, May 20.—In a previous article (see *Digest*, Feb. 20) he showed that the effective E. M. F. may be determined from the area and centre of gravity of the voltage curve; he now shows that the relative values of the hysteresis losses for different current curves are easily calculated. He proves that the hysteresis losses, assuming the Steinmetz law, must vary inversely with the 1.6th power of the distance of the centre of gravity of the E. M. F. curve from the time axis; the correctness of this result is shown, for the three curves, in Kapp's book.

Magnetization Limit of Iron. WILDE. Lond. *Elec. Rev.*, June 4.—A reprint of a short Royal Society paper, in which he gives the results of further tests to determine the magnetization limit; he believes that the magnetization limit was virtually arrived at and was 422 pounds, or 29.67 kilograms per sq. cm.; he used the single-pole method, and believes it compares favorably with the double-pole method; he measured it by the tractive force.

Magnetic Induction in the Earth's Magnetic Field. MASTENS. *L'Eclairage Elec.*, May 22.—A French translation of the article noticed in the *Digest*, April 3.

Cutting Lines of Force.—Engineering Journal, Cal., May.—Three brief communications, one by C. HERING, calling attention to an error in Kingsland's article on this subject, noticed in *Digest*, April 10, and showing that as he makes an incorrect assumption his conclusions are also incorrect. This is followed by a descriptive sketch by E. THOMSON describing a similar inoperative unipolar machine which he devised in 1887; his explanations of the reason why it is not operative being similar to those by Hering above noticed. This is followed by a discussion by PERRINE, in which he defends the loop theory as distinguished from the theory of cutting lines of force, endeavoring to show that the latter involves cumbersome explanations of some of the phenomena; he admits that there are no particular objections to the latter theory, as all induction effects may be explained if the reasoning is accurately applied, which latter he thinks may be very difficult.

ELECTRO-CHEMISTRY AND BATTERIES.

Rapid Charging of Accumulators. PICOU. *L'Eclairage Elec.*, May 29.—A short article giving the results of a number of tests made with the Blot accumulator: it had seven plates and weighed 8.5 kgs.; it had an active

urface of one sq. m. for every three kgs. of electrodes, two-thirds of which weight consisted of active load. The charges were made very rapidly and the discharges comparatively slowly; the first charge was made in 15 minutes at 14 to 18 amperes per kgs. of electrode; the energy efficiency was 70 per cent.; a charge at constant potential was made in a little less than an hour and the energy efficiency was 65 per cent.; the capacity of the accumulator was about 70 ampere hours; when charged in five minutes the energy efficiency was 61 per cent.; after the experiments there was no indication of the plates having suffered; the voltage was very constant during the discharge and the final fall was very rapid; the voltage was exceptionably high during the discharges.

Relation of the Capacity of an Accumulator to the Discharge Current. Peukert. *Elek. Zeit.*, May 20.—A short article in which he shows that the relation between these two quantities can be represented by a simple empirical formula (simple in appearance but not in its application), namely, that the current raised to a certain power *n* and multiplied by the time of discharge in hours, is a constant; the factor *n* depends on the particular type of accumulator, but the law is said to hold good for all types; he determined this number for 12 different accumulators (apparently from the catalogue information) and finds it to vary from 1.35 to 1.64; curves for most of these are also given. With the aid of this formula the capacity of an accumulator for any discharging current can be calculated, which he illustrates with an example. Such an exponential formula can be used only by those familiar with the use of logarithms.

Electrolytic Iron. Houllevigue. *L'Eclairage Elec.*, May 29.—Abstracted from the *Jour. de Physique*. He examined the various properties of electrolytic iron, comparing it with steel; such iron always contains hydrogen; it is attacked by air; its specific gravity is 7.324; its specific resistance differs but little from that of hard cast iron; the total and the permanent magnetizations are between those of hard and tempered steel; a permanent transverse magnetization diminishes the resistance perceptibly; there is therefore an analogy between iron containing carbon (that is, steel) and iron containing hydrogen.

Gold, Zinc and Electrolysis. Andreoli. *L'Elec.*, May 22.—The conclusion of his long article (see *Digest*, June 5). He continues the discussion of the relative merits of the electric and the zinc method and of his electric method as compared with that of Siemens and Halske; he also shows that the cost of the electric plant is not as serious as is often claimed; he copies a table of Gernet giving the cost of operating an installation of 500 tons per day, which amounts to about 63 cents per ton; he shows that the electrolytic process costs about 21 cents less than the zinc process.

Electrolytic Preparation of Insoluble Oxids and Salts.—Zeit. f. Elektrochemie, May 5.—A favorable editorial discussion by W. B. (presumably Borchers), referring to a recent patented process of Lucknow; it is considered one of the best processes and is thought to have a good future; the chief products appear to be the insoluble lead and copper compounds.

Manufacture of a Yellow and of Congo Red Coloring Material.—L'Elec. May 29.—Descriptions of two processes used in Germany for making these materials.

Electrolysis of Salt with a Mercury Cathode. Koch. *Elektrochem Zeit.*, May.—An illustrated description of a device in which the surface of the mercury electrode is continually being scraped off, this being essential in the successful use of such an electrode in which the sodium amalgam forms only on the surface and must be removed if the apparatus is to act continuously.

Manufacture of Hypochlorides and Chlorates. Oettel. *L'Eclairage Elec.*, May 22.—A translation of an article which appears to be the same as the one which was noticed in the *Digest*, Feb. 6.

Dissociation of Hydrogen Chloride. Jakowkin. *Zeit. f. Elektrochemie*, May 20.—An abstract from the *Berliner Berichte*, 30, p. 518.—He discusses the equation explaining the reaction.

Electrolysis of Alkaline Bromide and Fluoride. Pauli. *Zeit. f. Elektrochemie*, May 5.—The results of researches showing the action of potassium bromide and fluoride dissolved in water and subjected to the action of the current.

Electrolytic Reduction of Nitro Benzol. Loeb. *Zeit. f. Elektrochemie*, May 5.—A long descriptive article.

Electrolysis of Mixtures. Schraeder. *Zeit. f. Elektrochemie*, May 20.—If a mixture of copper and sulphuric acid is electrolyzed, then in general copper and hydrogen will be generated at the cathode; he investigated the question of what part of the hydrogen which is primarily set free is under various conditions replaced by copper; the article is quite long and contains considerable data.

The Law of Thermic Constants. Tommasi. *Elektrochem. Zeit.*, May.—A short article calling attention to a law announced by him in 1882 to the effect that if one metal replaces another in a salt the number of calories set free for each metal will always be the same whatever the acid or alkaline radical may be; for instance, if zinc replaces copper in any salt, 5.06 calories will be set free. He then gives a table which enables one to calculate the heat combination of all soluble mineral and organic salts.

Commercial Analysis of Copper by the Electrolytic Process. Hollard. *Elektrochem. Zeit.*, May.—An abstract from the French describing a process.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Copper Voltameter. Foerster. *Zeit. f. Elektrochemie*, May 5 and 20.—A long article on the copper voltameter, pointing out the reasons why it is often unreliable and describing how it may be made very reliable for measuring small currents. The article gives the results of what appears to have been a very thorough and extended research and contains numerous tables giving the results of comparisons and tests; these researches appear to be the most thorough that have been described for some time. In describing what takes place in the electrolysis of copper sulphates he shows that cuprous sulphate is formed, although to small extent; this compound is formed at the cathode at certain current densities; the error introduced thereby can, however, be made a minimum under certain conditions; the copper sulphate solution should be made very concentrated; the production of cuprous ions may be made negligible if the current density is not much below 0.5 ampere per sq. decimeter; the cathode should be completely immersed in the liquid on account of the complex action which takes place at the surface of the liquid; it is very desirable to add free sulphuric acid to the electrolyte; he recommends 125 grams of crystallized copper sulphate and 50 grams of pure sulphuric acid of 1.84 sp. gr. per liter of resulting electrolyte. He does not agree with Vanni, who recommends only a very slight acidity, giving his reasons, the chief of which is that the deposit is better when the acidity is greater; he agrees with the recommendations of Oettel that the accuracy of the copper voltameter is increased by the addition of alcohol to the electrolyte; Oettel recommends 100 gr. water, 150 copper sulphate, 50 sulphuric acid and 50 alcohol; the results of comparative tests are given; at high current densities the differences between the amounts of copper deposited with and without alcohol are within the errors of measurement, but at small current densities the differences become more important; the addition of alcohol is, therefore, to be recommended in working with very small currents; reliable results are obtained if the current density is kept at 0.4 amperes per. sq. decimeter or greater; by selecting the proper current density currents of several hundredths of an ampere may be measured satisfactorily, and from 0.01 to 0.005 amperes with an error of 0.5 "v. H." (the meaning of which is not explained); for small currents a cathode of a flattened platinum wire is recommended. Some of the remaining errors are considerably reduced when small currents for considerable time are to be measured, if the voltameter is protected from the action of the air; to do this it is arranged in the form of a bottle with a stopper, with glass tubes through which carefully purified hydrogen is passed; he then recommends using no alcohol; the anodes should be covered with parchment paper; he shows that very satisfactory measurements can then be made with small currents. He also recommends another method in which the electrolyte is first saturated with cuprous ions, under the exclusion of the atmosphere; one is then independent of the current density at the cathode and the concentration of the electrolyte; the current density should not exceed a certain amount, depending on the concentration of the electrolyte; the electrodes should be large enough, that a current density of 2 amperes per sq. decimeter is not exceeded. He discusses the use of the loss of weight at the anode instead of the gain at the cathode, and shows that this would involve greater inaccuracies. The copper voltameter, if properly used, is, therefore, not an inaccurate instrument, as is often supposed; it is simpler than the silver or mercury voltameter, although the latter has the advantages of a greater weight of the deposit.

Photometric Units.—Elek. Zeit., May 27.—A reprint of a long discussion at the German society concerning the adoption of a report submitted by the commission appointed to report on photometric units. The conclusions of this committee as given by Kapp, are published; they recommend as a unit the candle (Gr. Kerze) which is the horizontal intensity of the Hefner lamp; for the photometric quantities they give a table of names, symbols and units; for light intensity the Hefner candle, represented by *H. K.*; for the flux of current, which is the product of the intensity and a solid angle, the lumen represented by *Lm*; for intensity of illumination, which is the quotient of the above divided by the surface in sq. m., the lux (meter candle) represented by *Lx*; for brightness, which is the quotient of the candle power divided by the area in sq. cm., the term candle per one sq. cm.; and for quantity or output of light (Lichtleistung), which is the product of the flux of light by the time in hours, the term lumen-hour. He added that it was quite certain that the German Union of Gas and Water Engineers in its next yearly meeting will adopt these recommendations. They were discussed at considerable length, chiefly with reference to the German names used for the quantities; the symbols were also discussed and compared with those of Hospitalier. The report was formally adopted with a recommendation that a more satisfactory term be found for the last quantity. (This appears to finally settle the question of a photometric unit, and some of the terms, for electrical engineers in Germany.)

Photometric Units. Blondel. *L'Elec.*, May 22.—An abstract, of some length, of his report to the International Congress at Geneva held last August. The report was noticed in these columns quite fully at that time.

Measuring the Internal Resistance of Cells. Haagn. *Zeit. f. Elektrochemie*, May 5.—A short article describing a method; the one described by him in the article referred to in the *Digest*, May 22, under accumulators, is applicable only when the polarization capacity is great; the present method is to be used when that capacity is small and applies whether

electrolysis is going on or not; the principle is the same as that of Gordon for determining the polarization capacity, except that in the place of the air condenser a polarization capacity of aluminum plates is used; these in sulphuric acid have the property of offering a very large resistance a short time after electrolysis has begun; they are charged for only one minute; for alternating currents such plates act as an ordinary polarization capacity, whose capacity is the same as that of the cell to be measured and to which they are connected as a shunt; he assured himself that the method was correct by a comparison with other methods.

Measuring Large Electrolytic Resistances with Continuous Current. MALMSTROEM. *Zeit. f. Elektrochemie*, May 20; abstracted from the *Zeit. f. Phys. Chem.*, 22, p. 321.—He uses the ordinary bridge combination, the bridge current being passed only for such a short time as is necessary to determine the direction of deflection in the galvanometer, and that polarization does not take place, the current being commutated each time; platinized electrodes of 11 sq. cm. will answer well for resistances above 1,000 ohms; resistances of several hundred thousand ohms may be measured like those of wire and without platinized electrodes.

Polarization Capacities. GORDON. Lond. *Elec.*, June 4; abstracted from the *Wied. Ann.*, 61, p. 1.—He made an investigation with a new arrangement, shown in a diagram in the abstract; the cell whose capacity is to be measured occupies one branch of a Wheatstone bridge and also forms one of the resistances, the corresponding branch consisting of a known capacity and a liquid resistance; an alternating current with a telephone are used, and when equilibrium is obtained the capacities are inversely as the resistance in the other two branches. He thus found that for small currents the polarization is a strictly reversible process, and that the counter E. M. F. obeys Kohlrausch's equation; the resistances are correct with platinized platinum, but are too large with polished platinum.

Determination of Dielectric Constants. SMALE. *Zeit. f. Elektrochemie*, May 20; abstracted from the *Wied. Ann.*, 60, p. 605.—He described the determination for several salts by the electrothermic method with the use of the Nernst electrometer.

Measuring Alternating Currents with a Galvanometer. RAYLEIGH. Lond. *Elec.*, June 4.—A reprint of the paper abstracted in the *Digest*, May 22, under the title of "Determining the Angle of Lag"; in it he describes a successful form of a galvanometer with an obliquely situated soft iron needle.

Rapid Oscillations for the Wheatstone Bridge. NERNST. Lond. *Elec.*, May 28.—A brief abstract of a paper from the *Wied. Ann.*, 60, p. 600; apparently the same paper as was noticed in the *Digest*, June 5, under "Oscillations for Determining Dielectric Constants."

Oscillograph.—L'Eclairage Elec., May 29.—An abstract of the discussion between Blondel and Abraham at the French Physical Society.

Pyrometric Measurements. HOLBORN. *Elektrochem. Zeit.*, May.—An abstract of a contribution from the Reichsanstalt, describing practical systems of measurement with the Le Chatelier thermo cell.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Origin of the Telephone.—L'Elec., May 22.—A reprint of a short article by the Frenchman Charles Bourseul from the French journal *L'Illustration*, August 26, 1854, page 139. The article refers in general to the possibilities of transmitting speech electrically, and in it he suggests that if a person speaks close to a movable and very flexible disc, this disc may be made to make and break successively a circuit of a battery; another disc at a distance will produce at the same time the same vibrations. Further than this suggestion he gives no description; he says that it requires no special apparatus, and that a battery, two vibratory plates and a metallic wire would suffice. In conclusion he adds that it is certain that in the near or far future speech will be transmitted to a distance by electricity; also that he has commenced experiments in this direction; that they are delicate and require time and patience, but that the approximations obtained have enabled him to foresee a favorable result.

The Skin as a Telephone Receiver. MCKENDRICK. Lond. *Elec.*, June 4; abstracted from the *Proceedings of the Royal Society of Edinburgh*, 21, p. 251.—He found that telephone currents are within certain limits perceptible to the fingers dipped in solutions so that the body forms part of the telephone circuit, and he determined these limits; musical notes were transmitted and were felt by the fingers as thrills which corresponded to the intensity and rhythm of the note; it is thought that with some training a perfectly deaf person could be made to discriminate between all the various sounds given out by a phonograph by attaching a microphone to the phonograph, transforming up through the induction coil and receiving through the body as above described.

Horizontal Telephone Switchboards. ZWIETUSCH. *Elek. Zeit.*, May 27.—Comparative data for the system in Amsterdam, in which the horizontal switchboard is used, and the one in Christiania, where there is a vertical board, showing the advantages of the vertical type.

Telephony in Wurtemburg.—Elek. Zeit., May 27.—Tabular statistics from official sources.

Telephone Booths.—Elek. Zeit., May 27.—An illustrated description of bricks or tiles made of thick, hollow, corrugated glass blocks, laid in cement like bricks; they are said to be filled with compressed air; the object is to admit light freely but not to transmit sound.

Duplex Telegraphy with the Hughes Apparatus in Switzerland. WIETLISBACH. *Elek. Zeit.*, May 20; translated in abstract from the *Jour. Télégraphique.*—An illustrated description of an experimental system tried between Berne and Bale, where the differential method was used.

Telegraph Statistics.—Elek. Zeit., May 20.—A table compiled from the *Jour. Télégraphique* for the year 1895, comprising most of the countries of the world, except the United States.

Rapid Cable Laying.—Lond. *Elec. Rev.*, June 4.—An editorial discussing the recently described system of Cratchley and Snell. In the Lond. *Elec.*, June 4, Snell replies to the unfavorable criticisms in that journal.

Marconi Telegraph.—Lond. *Elec. Eng.*, June 4.—A brief reference to a lecture by Preece. He succeeded in signaling across the British Channel, between Weston-super-Mare and Penarth, a distance of 10 to 11 miles.

Wireless Telegraphy.—Elec. Rev., June 9.—A brief statement to the effect that Tesla has succeeded in telegraphing without wires, but no description whatsoever is given; it is said to be independent of earth currents or the points of the compass and to require a surprisingly small expenditure of energy; he uses "the electrostatic equilibrium," the disturbances of which can be distinguished at a distant point. The New York Sunday *Sun* states that he was able to signal 20 miles, but he confesses that the system is still liable to break down in bad weather.

MISCELLANEOUS.

Laboratory Furnace. BONNA and LEKOYER. *Zeit. f. Elektrochemie*, May 5.—A very brief description of a form which they have found to be very convenient. Those made of lime are said to be impractical, as both the lime and the crucible are lost as soon as the crucible is attacked; they therefore use a split cylinder of sheet metal held together with separable collars; the crucible is placed inside and the space between it and the metal is filled with broken carbon mixed with a quarter of its weight of sugar; at the bottom these is a conducting plate for making contact; the mass becomes soft when very hot and the crucible can then be pressed down so to make good contact.

Trees and Lightning.—L'Elec., May 29.—An abstract of an article by Hess, consisting chiefly of the results found by Jonesco noticed in the *Digest*, June 6, 1896, with some additional results made by Hess.

Efficiencies of Ozonizers. E. A. *L'Elec.*, May 22.—A short article discussing and criticising unfavorably the claims of efficiencies made by Otto and others.

Prize; Permanent Magnets.—L'Ind. Elec., May 25.—A note stating that a prize of $600 is offered for 1898 for the best work done in the manufacture of permanent magnets; it is not stated whether the prize is open for international competition.

Burglarizing Safes. SUMMERS. *Elec. Eng'ing*, June 15.—The results, in the form of curves, of a test made to determine the practicability of the electrical method; an average of 350 amperes at 85 to 90 volts and 25 to 27 minutes was required to penetrate a plate 7 inches thick; 150 to 200 amperes were used with 4-inch plates without difficulty; there was an advantage in using a long arc, as it located the arc at the end where it is wanted; the current was obtained from the street mains at 230 volts; the total weight of the apparatus was less than 50 pounds; no particular skill was required; it was shown that there was no particular difficulty in obtaining the necessary current when it was less than what the building was wired for; he concludes that there is no difficulty in the process and that the currents are readily obtainable from storage batteries or from an electric light plant capable of supplying a town of 5000 inhabitants. (In none of the numerous "practical" articles on this subject does it seem to have occurred to the authors to explain how the contents of a safe are to be removed after a small hole has been burned through the side. Some of the articles which were noticed appear to be disguised advertisements of protecting systems for safes.)

Economy in Electric Cooking. WOODBRIDGE. *West. Elec.*, June 12.—He compares electric with the other system of cooking, showing when the former can be used to advantage. The heat from ordinary illuminating gas at $1.25 per thousand costs $2.50 per million British thermal units; heat from electric power at 12.5 cents per kw costs $36.75 per million units; he calls attention to the well-understood wastes in both systems, showing that far greater economy of heat is possible in the electric system; the simple expedient of covering a kitchen utensil with heat non-conducting material was shown by an experiment to effect a saving of 80 per cent. Wherever hot water is supplied from a central heating plant, as in flats, the reduced radiation possible with electric cooking would probably be enough in many cases to offset the lower cost of other sources of heat; wherever economy is an object electricity had better not be used for heating water.

Wellman Hearth Charging Machine. HEADE. *Elec. Eng.*, June 2.—Ah abstract of his recent paper which was noticed in the *Digest*, May 20. The *Eng. Mag.*, June 5, contains an illustrated abstract of the same paper describing this machine, which is operated electrically.

A New Injector Condenser.

The practical advantages of a condensing apparatus for simple or compound engines is now so generally understood and appreciated by engineers that it is unusual to find an engine of any size installed in electric light or power stations where a condenser is not used, if the conditions will admit of its use. A positive and direct saving in steam (of from 20 to 25 per cent.) may be effected in this way, or an addition to the power of the engines of from 25 to 30 per cent., depending somewhat upon the efficiency of the engine and the condenser. This result is effected by the

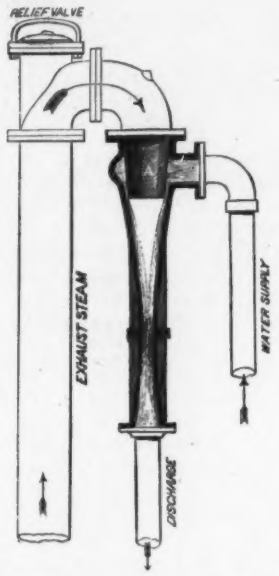


Fig. 1.—Sectional View of Injector Condenser.

condenser in the removal of the greater part of the atmospheric resistance, as well as of any other back pressure that may exist in the engine.

This gain will average 12 pounds per square inch, and a very simple calculation will then demonstrate the saving or gain in power mentioned which is sure to follow the use of an effective condenser.

The disadvantages of the ordinary independent or connected air-pump condenser are its complication, the large amount of power required for its operation, and the liability of damage to the engines connected by

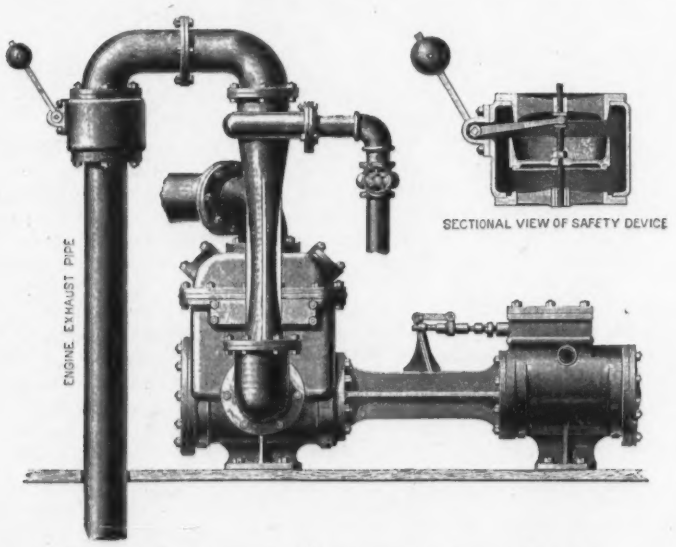


Fig. 2.—Injector Condenser with Steam Power.

drawing back water into the engine cylinders at an early cut-off, or in starting or stopping.

The Bulkley "Injector" condenser, manufactured by Henry W. Bulkley & Co., of this city, has been in use on engines of every size and style for many years by many of the leading manufacturers, as well as in electric light and power stations. A set of eight condensers, aggregating 5,000 horse-power, has recently been installed in the new station of the Edison Electric Illuminating Company of Paterson, N. J.

This condenser is radically different from all others, as the "injector" principle is here used in connection with siphoning supply and discharge pipes, by which means the air pump required with other condensers is dispensed with. A very high vacuum is thus maintained, entirely by the use of the exhaust steam and the condensing water.

Referring to Fig. 1, it will be seen that the condenser is of the "injector" form (hence the name), the condensing water entering at the side opening, passing downward around the exhaust nozzle in a thin circular film. The exhaust steam is thus condensed within a hollow cone of moving water, which by its velocity through the contracted neck of the condenser expels the air and vapor into the discharge pipe below.

The water column in this discharge pipe being long enough to overcome the pressure of the atmosphere, it delivers into the hot well by gravity. In Fig. 3 is shown a usual method of attaching the condenser, it being connected with the exhaust pipe of the engine at a height of about 34 feet above the level of the water in the hot well.

A tight discharge pipe extends from the condenser nearly to the bottom of the hot well, so that it is always sealed by the water in the same. The area of the discharge neck of the condenser is greater than the capacity of the circular water inlet above, and the height of the column overcomes the pressure of the atmosphere, consequently the water cannot be forced or drawn over into the cylinder of the engine.

The condensing water may be supplied by a steam pump, or by a centrifugal, a rotary, or a steam-piston pump driven from the shafting, and where a natural head of 10 feet or more of water is available, the condenser will readily siphon the water the remainder of the height, after being started, without requiring any pumping device. When a pump is used, as it works cold water only, it will be readily seen that it need be only about one-third the size of the air pump required with other forms of condensers. The pressure of the atmosphere elevates the water about 26 feet after the vacuum forms, so that the load on the condenser-supply pump is reduced to a very small amount. In many instances, the condenser may draw its supply from a tank already in use, merely by increasing the speed of the pumps supplying the same.

The heater (shown in Fig. 3) is also made by Messrs. Bulkley & Co., and having a direct passage for the exhaust steam to the condenser, as well as a very effective heating surface, it can be used with economy between the engine and the condenser.

At the upper end of the engine-exhaust pipe, or where most convenient, is the automatic relief valve, which permits the exhaust steam to discharge into the air whenever the vacuum is lost.

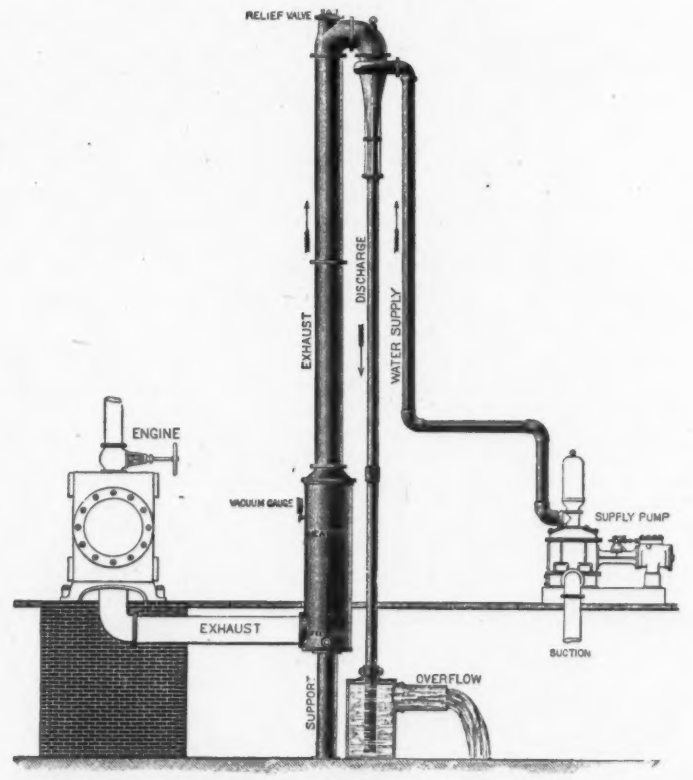


Fig. 3.—Condenser with Supply Pump, Heater, etc.

Where the use of an air pump is not objectionable, a combination that possesses peculiar advantages is used, consisting of air pump combined with an injector condenser, as is shown in Fig. 3.

The exhaust steam is condensed within a cone of moving water, and imparts to it a velocity that enables it to expel the air and vapor into the suction opening of the pump. The momentum of the water thus materially assists the pump by reducing its load, and a high vacuum is maintained by the combined action of the condenser and the pump. The pump may exhaust into the condenser, or into the receiver of the engine, and it will form the vacuum before the engine is started.

Its steam cylinder has a recently patented valve motion, of improved design, and the pump is brass lined, with brass water piston and valve seats, etc. Special attention is called to the Bulkley patent safety device, by

which all danger of working water over into the engine cylinder is avoided. It is placed, as shown in the illustration, in a chest located in the exhaust pipe, between the engine and the condenser, and it consists of a cup shaped valve, with guiding spindles, balanced above its seat by means of the rock shaft, levers and weight in the position shown. It will be seen that any backward movement of the water from the condenser toward the engine cylinder will be directed into the cup valve by the inlet nozzle above, which will instantly close it, thus effectually sealing the entrance to the engine cylinder.

This safety device is of great value with any form of air-pump condenser, as all of them are liable to work water back under certain conditions unless provided with some arrangement of this kind, as many users of steam have found to their sorrow.

The Bulkley condenser is used in various combinations, and with a single exhaust-pipe from several engines, if desired, although it is much more desirable to use a separate condenser for each engine of any size, thus making every engine independent of the others.

An important feature of this condenser is the fact that the manufacturers guarantee its operation with about 1 per cent. of the maximum engine power with which it is used.

Resistance Measurements.

In electrical measuring instruments few are more important than the Wheatstone bridge, and this has come to be realized by the student, the engineer and the station manager to such an extent that to explain the advantages of this method of measuring resistances, or testing for broken circuits, short circuits and grounds would be a waste of time and space. The main requirements of such apparatus are that it should be portable, convenient, easy to operate, durable, accurate under all general conditions, must have a wide range and must be low in price.

About a year ago the Whitney Electrical Instrument Company, Penacook, N. H., realizing that apparatus combining all of these conditions was

A PORTABLE TESTING SET.

not easily obtained, commenced a line of experiments, and in presenting the Whitney portable testing sets, it offers the result of several months' study, and an instrument that has been thoroughly tried and every weak feature eliminated. That it has complied with all of these requirements the following description of the instrument will show. In size the instrument is 8 by 5 by 5 1-2 inches and it weighs five pounds. The company guarantees it to be accurate to within one-fifth of 1 per cent., and with it resistances as low as one-tenth of an ohm can be measured. The rheostat arms are formed by the two outside bars and have a range of from one ohm up. The central bar comprises the two bridge arms, and by plugging or unplugging the ratio coils in these arms the value of the rheostat coils is divided or multiplied as desired.

The galvanometer is designed with special reference to being extremely sensitive and quick to respond with a small current, and in the measurement of low resistances the use of one cell will be found ample.

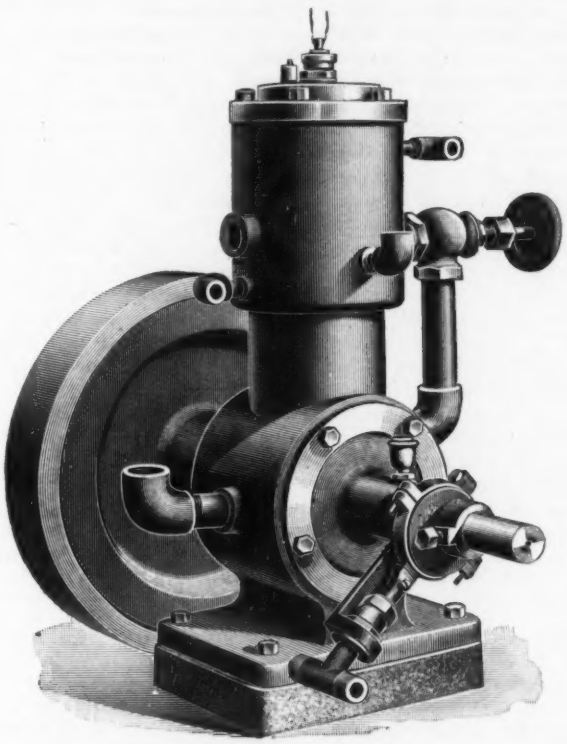
These testing sets are made in two styles, with batteries for outside testing and where access to batteries is not convenient, and without batteries for school and laboratory work. The type containing batteries is furnished with six cells, so arranged that from one cell up to the full battery can be used. The instrument is also provided with two binding posts, so that battery current from an external source can be used if desired. The battery is of the chloride of silver type, and is especially selected for its permanence and efficiency. The cells will last several months in constant service, and may be renewed at a very small expense. The instrument is mounted in a handsomely polished mahogany case, and all the metal parts are substantially finished in lacquer.

The resistance is of a special alloy, carefully made for the use of this company, and highly insulated. There is therefore no appreciable temperature error under general conditions. At the present time these sets are being made in a variety of ranges up to 5 megohms, and it is the intention of the manufacturers to build them with still greater capacity.

Small Gas Engine.

The demand for gas engines of small power has received the attention of Messrs. Palmer Brothers, Mianus, Conn., the result of whose work in this direction is illustrated herewith. The engine represented is of the vertical gas and gasoline type, and the firm furnishes it complete or the castings of the same with working drawings, to enable amateurs and others to put the engine together themselves if they so desire. It is of the marine type and will run a boat 16 or 18 feet long, or it may be used to propel a light motor carriage. It possesses the great advantage of operating in either direction, and when used as a stationary engine it will run light machinery. The portable engine has a pump to circulate water in the water jacket, and in the stationary form a tank is used instead of a pump.

These motors are built on the two-cycle compression system, with an impulse at each revolution of the crank. The charge is received through a cylinder port opened and closed by the movement of the piston, and the exhaust is effected in a like manner. A suitable valve regulates the charge received from the closed crank chamber, in which the mixture is compressed by the downward stroke of the piston. Vapor and air are drawn into the crank case by the upward stroke of the piston and thoroughly



A SMALL GAS ENGINE.

mixed by the motion of the crank. The circulating pump is shown in the illustration.

The height of the stationary engine is 23 inches and that of the marine engine 17 inches, and the weights are 200 pounds and 135 pounds, respectively.

The compactness of these engines is one of their most desirable features, and no doubt this machine will find a ready market on account of the constant call for a gas motor of small size.

The Duty on Mica.

THE ELECTRICAL WORLD recently received a very interesting communication from Mr. Charles W. Jefferson, of Eugene Munsell & Co., New York, concerning the proposed duties on mica under the new tariff. Mr. Jefferson says:

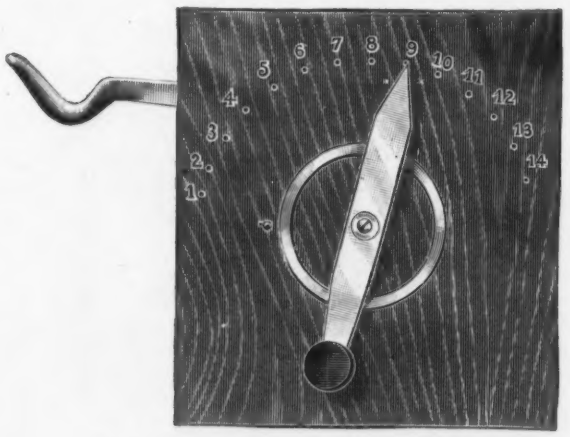
"The general refrain is that mica is too cheap. If we could only increase the cost of mica three or even five-fold, the country would be richer. If we could stop the importations profitable mines would be opened up in almost every State in the Union. Is this the truth? From my own experience it is not. The true cause of the low price of mica is owing to the fact that the supply greatly exceeds the demand. And, even at the present low rate of prices, the material is looked upon as a necessary evil, on account of its cost, by every consumer, and the tendency is to use pieces as small as possible. The smaller the piece used the greater the labor entailed, so in all cases an equilibrium has to be struck which balances the price of the mica with the subsequent labor. If the price is increased, smaller sizes will be used, and vice versa. If the price is reduced large sizes can be used, and, what is of greater importance, owing to the oversupply, larger quantities also.

"Everyone knows that mica varies greatly in its properties, especially in hardness and transparency. North Carolina and Dakota mica, and mica from other States, stands at the head in combining these two properties—excessive hardness and perfect transparency—and this mica has nothing to fear from competition with that of other countries. It will always command a fair price, if the consumption is not interfered with in any way. The mining industry in the States concerned will be in a healthy condition. The consumers of this quality of mica are the stove manufacturers, the makers of lamp chimneys, shades, etc., and to a limited extent the electrical manufacturers. Although the electrical manufacturers use this kind of mica where its qualities are required, the bulk of their supply happens to come from Canada and India. Both of these countries possess mica of exceeding softness, the quality which is absolutely necessary for electrical uses. Canada, with its high-priced labor, successfully competes with India, and so would this country if it only had the proper qualities. Soft mica has not been discovered in this country, and the electrical manufacturers must have it at any price. No electrical engineer in his senses would think of using a hard mica when a soft one was essential. He would rather use a substitute, such as paper or fibre, which may be said to rank as the next best practical insulator. Paper at 3 cents, mica at 19 cents—a pretty comparison, to be sure! Any increase in the price of mica is certain to result in a decreased consumption, and it is to the interest of everyone in the mica business, whether he be a miner or importer, that the price of mica be as low as possible. The increased sales at a low price will more than offset the small sales with a larger profit.

"Whatever tax is put upon the mica imported from other countries will not increase the price of mica mined in this country. There is already an over production. It would increase the price of the soft mica imported from Canada and India, and there would be a stronger tendency than there is now for the electrical manufacturers to use entirely different substitutes. It is due to the electrical manufacturer to say that he has scoured the world over to find a suitable cheap mica for his purpose, and the present duty of 20 per cent. is a severe tax upon his business, and the question of using mica at all is always before him. If from any cause the price is greatly increased a great blow will be struck at the mica business, and the miner, whether he be in Dakota or India, will equally suffer. It will not only be the miner, but the electrical manufacturer also. There is no business in the country that has brighter prospects of sending its product abroad than that of the electrical manufacturer. Only the other day one of them secured contracts in England and Australia entailing an outlay of over one million dollars. In fact they are now looking forward to their export business as their chief outlet, and any tax on them when competing with Germany and England, and that on mica is about the only one, might result in a loss to the foreign business to the amount of millions of dollars."

A New Telephone Switch.

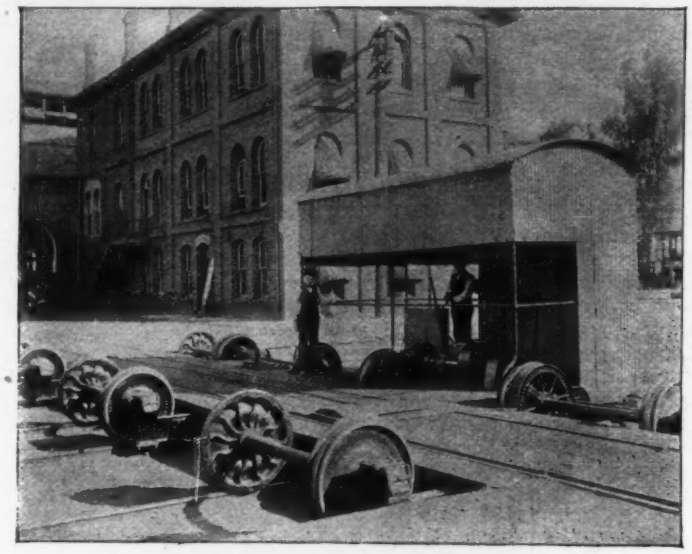
A new style of switch for use on intercommunicating telephone systems has recently been put upon the market by the Mianus Electric Company, Mianus, Conn. The peculiar feature of this switch is that when the conversation is finished and the receiver returned to the hook, the switch automatically returns to the home number or position for receiving another call. Considerable trouble has been found in many intercommunicating installations, owing to the fact that users of the telephone sometimes forget to return their switches to the proper position when through talking. This is accomplished automatically in the new switch and so always leaves the telephone in readiness to receive the next call. The new switch is mounted on a base ready for attachment to the backboard of the telephone set. The same company is also putting on the market some new lines of magnetos, receivers and other telephone parts.



Intercommunicating Telephone Switch.

Electric Power in Railroad Shops.

The use of electric motors in railroad shops is extending as the advantages which electric drive presents over steam or compressed-air drive for the heavy machinery to be found in such shops are being brought home to those who have them in charge. Instances are multiplying throughout the country of the installation of electricity in lieu of steam or compressed air. Recently the completion of the long-distance transmission line between Folsom and Sacramento, Cal., has placed it within the power of the Southern Pacific Railroad to use motors in its shops at Sacramento with most satisfactory results. In their operation the motors have already shown considerable economy over the original steam plant which they superseded. The motors are placed in the shops where steam engines had previously been used, and the difference between the results obtained, apart from the mere question of economy, is marked.



Transfer Table in Sacramento Shops.

Three motors are used; the first, a direct current motor placed upon a transfer table used for shifting the locomotives. The motor is a G. E.-800 similar in every respect to those used on the ordinary trolley car, and is driven by 500-volt railway current from the station. It is so geared that it operates not only the table but also drives a drum carrying a wire cable used to haul the locomotives upon the table. This it does with perfect ease, hauling all sizes of locomotives. Instead of taking the current from the overhead wire by means of a trolley, the conductors are laid in an underground conduit and the contact is made by means of a plow running in this conduit.

The motor used to operate the machinery in the boiler shop, as well as in the tender shop, is a 50-hp motor driven by 440-volt current from the step-down transformers. The machinery in these shops is peculiar in that each machine is provided with a heavy flywheel for carrying it over the sudden shocks which occur in punching and shearing and similar work. For three or four minutes the motor has an excessive amount of work thrown upon it in starting the machine from idleness and until the maximum speed is acquired. The load then drops to 30 horse-power.

The two motors last named are of the General Electric Company's three-phase induction type, without commutator, collecting rings or brushes. They are driven by 440-volt three-phase alternating current from the transformers which step down the 11,000-volt current transmitted 24 miles from the generating station at Folsom. This installation is only one of many made since the completion of the transmission from Folsom to Sacramento, which latter city is rapidly becoming dependent on electricity as its exclusive motor power.

New Trolley Ears.

The Ohio Brass Company, Mansfield, Ohio, has recently placed upon the market two modified forms of the Walker straight-line trolley ear, which they exclusively manufacture. Both these styles of ears contain all the features which have made the straight-line ear so universally liked, differing from it only in so far as it is necessary to make them suit the special conditions under which they are used in practice. With the addition of these new designs to those which this company have already been making, all the different styles of ears of the Walker type necessary to suspend trolley wire in position throughout its entire length is offered to the trade. The Walker ear is already so well known that an extended description of it at this time would probably not be of interest on this account. It is sufficient to say that it is meeting with greater favor than ever, and has been adopted recently by several of the largest electric railway systems in this country.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 14, 1897.

ELECTRICAL STOCKS.—There was a general stronger feeling in this list of securities during the week, the closing quotations showing advances over the previously recorded prices. Electric Storage Battery, common and preferred, are both higher, and General Electric common closed with a net advance of 1⅜ on the week's transactions. The sales of this stock for the week amounted to 19,480 shares. Edison Electric Illuminating of Brooklyn is 2⅞ higher, and Edison of New York is ½ point lower. The sales of the latter were 250 shares, and of the former, 200. Fifty shares of General Electric debentures were sold at an advance of 4½ points.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	115	116½
Edison Electric Ill., Brooklyn	100	105	108½
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	19½	19¾
Electric Storage, pref	100	20⅛	20¾
General Electric	100	33⅛	33½
General Electric, pref.	100	68	72
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	112	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	100	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	230¾	231
American District Telegraph	100	..	35
American Telegraph and Cable	100	88	90
Central and South American Telegraph	100	124	127
Commercial Cables	100	165	..
Erie Telephone	100	64	65
New England Telephone	100	104½	105
Postal Telegraph Cable	100	100	..
Western Union Telegraph	100	81⅝	81⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19⅛	19¼
Brooklyn Rapid Transit	..	22⅜	22½
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	69	71
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	43
Hestonville	100	50	51
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	26	30
North Shore Traction	100	18	20
North Shore Traction, pref	100	75	78
Rochester Street Railway	..	10	13
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	102
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	82	..
West End, Boston, pref	100	91¼	92
Worcester Traction	100	13	15
Worcester Traction, pref	100	92	94
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	77	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge.. 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	104½	107
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

TELEGRAPH AND TELEPHONE.—There are no marked changes in these lists. Bell Telephone closed at an advance of about 3 points. Commercial Cable is up 2½, and Western Union 1⅞. The sales of the latter stock for the week were 60,121 shares. Erie and New England Telephones declined a fraction each.

ELECTRIC TRACTIONS.—There was very little trading during the week, business being practically at a standstill. Changes in quotations are fractional in the main. Brooklyn Rapid Transit showed some strength, closing the week with a net gain of 2⅜ points. The number of shares sold was 3806. West End showed some activity, but reacted, closing the week at an advance of 5 points over the previous quotation.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN reports gross earnings for May of $66,083, an increase of $4616, as compared with the same month last year; and net earnings, $24,794, an increase of $3642. For the five months ending May 31 the gross earnings were $359,366, an increase of $22,903, as compared with the corresponding period of last year, and net earnings, $149,291, an increase of $19,443.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 17, 1897.

MR. P. C. BURNS, president of the American Electric Telephone Company, of Chicago, called at the office of THE ELECTRICAL WORLD a few days ago. Mr. Burns says that his company is meeting with unusual success in business, and that he will be present at the forthcoming Detroit Convention, where he hopes to exhibit some of the apparatus and specialties which his company manufactures.

THE AMERICAN DISTRICT TELEGRAPH COMPANY'S messenger service obtained particular prominence during the recent Evening Telegram bicycle parade, on Saturday, June 5. Forty-four messenger boys, composing part of the very efficient bicycle corps of this company, took part in the parade, and were awarded a prize in the shape of a very fine silver cup for their excellent display and efficient manoeuvering. The prize was presented at the Casino Theatre on Monday, June 15, and Superintendent Rayens, Inspectors Riley and Morris, and Manager Skelton, were not a little overjoyed at the fact that the messenger boy has at last become a prize-winner.

SPEED IN MESSENGER SERVICE.—A recent discussion regarding the rapidity of messenger service in this city among a coterie of gentlemen in one of the downtown restaurants, resulted in one of them going to a messenger call-box and ringing for a boy. Bets were made regarding the time interval between the ringing of the box and the arrival of the boy. None of them were, however, below two minutes' limit, as the central office is some two and one-half blocks away from the point at which the box is located. To the great astonishment, however, of all those assembled, the boy arrived in less than a minute, which all goes to show that the humorous papers must now find a new field, as the messenger boy has now graduated.

THE DELAY IN EQUIPPING THE TRACTION LINES.—The apparently endless discussion over the opening of Sixth and Eighth Avenues for the construction of the Metropolitan Traction Company's proposed electric underground system, goes on in the same weary fashion. The most recent developments have been the suggestion on the part of the Mayor that the Sinking Fund Commissioners desire to know what the Traction Company is willing to pay for the privilege of operating its system in these streets. The railway company replied in effect that it already had possession of the streets, and that as the city had nothing to sell it, it was not in the market to make bids. The prospects for a speedy solution of the difficulties seem to be as small as ever.

NEW ENGLAND NOTE.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave,
BOSTON, Mass., June 16, 1897.

THE PROVIDENCE (R. I.) INDUSTRIAL EXHIBITION in honor of the Pan-American visitors was formally opened by the Governor of the State, Thursday morning, June 17. The exhibition is in the new Fuller Building, on Sabin Street, admirably adapted for the purpose, and a most excellent display of the manufacturing interests of the State of Rhode Island is attractively made. The electrical exhibitors include the General Electric and Westinghouse Companies, Hope Electric Appliance Company, Drake, Payson & Whittier Electric Company, Rhode Island Telephone & Electric Company, and others; and allied manufacturing interests, such as Corliss Engine Company, Brown & Sharpe Manufacturing Company, American Screw Company, Mossberg & Granville Manufacturing Company, New England Butt Company, Nicholson File Company, Builders' Iron Foundry, all of whom have important and tasteful exhibits.

Buffalo and Niagara Falls Notes.

Niagara Falls, N. Y., June 16, 1897.

THE BUFFALO TRACTION COMPANY.—Mayor Jewett, of Buffalo, has approved the resolution of the Common Council which allows the Buffalo Traction Company to lay its first 15 miles of track within the city limits, according to the plans which have been filed with the Commissioners of Public Works. Some of the Councilmen made a vigorous protest against this affirmative action by the Mayor, but without avail.

A NEW WATER-POWER SCHEME AT NIAGARA.—Another scheme for the development of power in Niagara River has come to light. C. H. Mitchell, of Niagara Falls, Ont., is the father of the new idea, and he has made application to the Council of that village for a franchise. There is said to be a fall of 46 feet in the river between the Cantilever Bridge and the whirlpool, and Mr. Mitchell believes it is the most valuable water power available in the locality. at the present time. Immediate steps will be taken to harness some of the power, of which so much is going to waste in the rapids.

RAILWAY FROM WELLSVILLE TO BOLIVAR.—New electric railway schemes and electric railway companies are springing up like mushrooms all over the country. The latest comes from Wellsville. It is almost certain that within a few months New York capitalists will build a trolley road from that town to Bolivar, by way of Allentown. The line will be 16 miles long, and will cost about $175,000. Cheap fares and quick service will be the features of the new road. The plans are now to start a car each way every two hours, and to charge 50 cents for the round trip from Wellsville to Bolivar. A line from Olean to Portville is also being agitated, and if this is built the two new roads will be connected, giving a through electric railway from Wellsville to Bradford, Pa.

Pittsburg Notes.

Pittsburg, Pa., June 16, 1897.

ANNUAL MEETING OF STOCKHOLDERS.—The stockholders of the Westinghouse Electric & Manufacturing Company are notified that their annual meeting will be held in the offices of the company at its shops in East Pittsburg, Pa., on Wednesday, June 23, at 10 o'clock A. M., for the election of directors and for the transaction of such other business as may properly come before the meeting.

TRACTION COMPANY CHARTERED.—On May 31 a charter was issued at Harrisburg to the Meadville Traction Company, of Meadville, Pa., with a capital stock of $350,000. The company will build and operate a trolley road between Meadville, Cambridgeboro and Edinboro, in Crawford and Erie Counties. The incorporators are F. R. Shryock, Charles Fahr, George D. Trowen, H. H. Thompson, John J. Shryock and Cyrus See. The intention is to extend the road to Erie eventually, and to do an express, as well as a passenger business.

CONTRACTS AWARDED.—Bids were received on June 7 for all supplies required for the ensuing year by the Bureau of Public Lighting in Allegheny. The sub-committee appointed to tabulate the bids met on June 10 and decided to recommend the awarding of contracts, item by item, to the lowest bidder on each. Under this plan the Washington Carbon Company will get the carbon contract, and the other supplies will be furnished by the Westinghouse Electric & Manufacturing Company, the Doubleday Electrical Company and the Western Electric Company.

OPPOSITION TELEPHONE MEETING.—The Interstate Telephone Association, an organization composed of men interested in the telephone business in the territory in which the American Bell is represented by the Central District & Printing Telegraph Company, held its second annual convention at the Monongahela House last week. The situation in view of the Berliner decision was thoroughly discussed by the fifty or more members present at the meeting, and it was decided to hold another meeting in Pittsburg in the near future, and in the mean time to strengthen the organization as much as possible. Steps were also taken toward the establishment of long-distance lines by the local exchanges opposed to the Bell Company.

St. Louis Notes.

St. Louis, Mo., June 14, 1897

OUT TO CLAYTON.—The Delmar Avenue & Clayton Railroad was opened last week. It connects with the Midland Railroad, and will give the Lindell Company a through line from down-town to Clayton.

INTO THE SUBURBS.—Preparations are being made by both the Lindell and the Union Depot Railway Companies to extend their lines into the suburbs through Gratiot, Lindenwood, Shrewsbury, and eventually to Webster, Kirkwood and Meramec Highlands, all nearby towns.

TO BE REORGANIZED.—The Carondelet Electric Light & Power Company is about to be reorganized, and new capital will be put into the company. A special meeting is to be held, at which it is probable arrangements will be made to pay off the present fixed indebtedness of $35,000, and a floating debt of a little less than $5000. The capital stock is $100,000. It is the purpose of the company to supply electric light to the residents of Carondelet.

THE IMPERIAL COMPANY'S NEW SITE.—The Imperial Electric Heat, Light & Power Company has leased a valuable building site at the corner of Ninth Street and Washington Avenue, and will begin building operations about September 1, when it will get possession of the new site. New machinery will be installed, and the company will then have one of the most complete plants in the West. It will furnish electric power for all purposes, and will also lay steam-heating pipes to reasonable distances, supplying heat to buildings in the vicinity.

English Notes.

(From Our Own Correspondent.)

London, June 9, 1897.

ELECTRIC LIGHTING SHARES.—A city note in a financial paper gives a very good idea of the financial status now attained by the shares of electric lighting companies in the metropolis. They point out that at the end of February last the total market value of the shares of eight metropolitan electric lighting undertakings amounted, in round figures, to £3,500,000 sterling, while to-day they stand at £4,500,000, an appreciation, therefore, within three months, of nearly 25 per cent. The par values of the shares concerned is under £2,000,000, so that the premium at the current quotations amounts to no less than 122 per cent.

MUNICIPAL ELECTRICAL ASSOCIATION.—This enterprising association holds its second annual meeting in Manchester on June 30, July 1, 2 and 3. On Wednesday, June 30, there will be a presidential address by C. H. Wordingham, electrical engineer to the Town Council of Manchester, and on that day also there will be papers read for discussion relating to the generation of steam and to municipal wiring. On the following day there will be discussions on papers relating to electric street lighting and electricity meters, and on Friday two papers will be contributed on distributing systems, and one on the localization of faults. Saturday will be devoted to formal business. The afternoons of the days mentioned will be devoted to excursions to various electric lighting stations.

THE COST OF GAS ENGINES FOR ELECTRIC SUPPLY STATIONS.—The recent article in "The Electrician," comparing the costs of driving by gas and by steam, at Coatbridge, has induced Mr. W. Langdon, of the Midland Railway Company, to disclose some particulars of the working costs of the gas-driven electric light station at Leicester, which station is used for lighting the railway station and yards at that place. The Leicester gas engine station has a total capacity of 250 electrical horse-power, of which 75 is held in reserve. The whole plant is driven by gas engines, supplied with Dowson generator gas, which is produced from anthracite coal, costing 16s. 6d. per ton. The output of the station for the last half of 1896 was 147,302 units, and the following are the items of expenditure: Total cost, £1,944:10:4; total cost per unit, 3.17d.; cost for labor, 1.30d.; cost for material, 0.97d.; cost for repairs, 0.25d.; cost of coal, 0.205d.; cost of town gas when used, 1.34d. It should be added that town gas is held in reserve in case the Dowson gas generators should fail, and is only used at rare intervals, except for short jobs or experimental runs.

MARCONI TELEGRAPHY.—On Friday evening last Mr. Preece delivered a Friday evening discourse at the Royal Institution on "Signalling Through Space Without Wires." The lecture was of a popular description, but was important, inasmuch as it contained the first public authentic information as to the exact scope and nature of Mr. Marconi's invention. As is frequently the case, Mr. Marconi, with his Italian name and mysterious manner, considerably impressed the curious gentlemen who write science for the daily papers. We were given to understand that his waves were quite other than Hertzian waves, and that he had made something in the nature of a scientific discovery instead of improving in detail any apparatus. Although it has been an open secret for some time past that Mr. Marconi's merit consisted solely in having devised a sensitive and reliable form of "coherer," Mr. Preece's lecture was, as I said, the occasion of the first public and authentic statement with regard to this. Mr. Marconi's coherer consists of silver electrodes contained in a vacuum tube (4 millimeters), the electrodes being separated by a thin layer composed of nickel and silver filings (nickel, 96 per cent.; silver, 4 per cent.). The resistance of this is enormously reduced when electric waves impinge upon the tube, and upon the resistance falling, a battery, in circuit with a Morse "inker," is able to work that instrument and record the signals sent out by the transmitter. In series with the Morse "inker" there is an electromagnetic "tapper" which restores the high resistance of the metallic mixture as soon as the signal has been received. Mr. Marconi's transmitter is of the Righi pattern; that is to say, an induction coil causes sparks to pass between a succession of hollow metallic spheres, the middle ones of which are partly immersed in vaseline oil. With a view, it would seem, of increasing the capacity (although the inventor says it is with a view of clearing intervening obstacles and thus obtain a free passage for his waves), he connects electrically to his transmitter either a metallic cone at the top of a pole, 100 feet high, or to a kite. With this device Morse code signals have been sent across the Bristol Channel from Penarth to Weston-Super-Mare, a distance of 8 miles, at the highest speed attainable by hand-worked Morse apparatus. I understand, however, that Mr. Marconi is not yet satisfied with the speed attained, and I learn that a well-known telegraph engineer is now engaged in devising for him a more suitable and sensitive telegraph relay. Mr. Marconi left yesterday for Italy, whither he has been called by the Italian Government. Considerable mystery has been made of the fact that hills do not interpose an appreciable resistance to the waves emitted by the Marconi apparatus, and that he can work one of his receivers even when it is inside a metallic inclosure. Seeing that he uses waves of about 48 inches in length, as against the 8-inch waves used by Dr. Lodge, some three or four years ago, in his memorable experiments, it does not seem to me that there is anything very wonderful in either of these facts. Dr. Lodge found it very difficult to keep his 8-inch Hertzian waves outside a metallic inclosure of ordinary conductivity and thickness, and he found no difficulty in getting through a reasonable number of brick walls. A fortiori, therefore, one would expect Mr. Marconi, with his much-longer waves, to do much better. Perhaps, also, this great wave length may explain the tremendously increased range of the Marconi apparatus as compared with that used by Dr. Lodge only three years ago. The increased range certainly cannot be attributed to the amount of power employed by Mr. Marconi, since he only uses, to work the induction coil of his transmitter, about six or seven storage cells, giving a current of two or three amperes. The Italian inventor promises to give technical details and quantitative data to a scientific or engineering institution in the autumn. Electrical engineers and others will look forward to this with great interest.

General News.

NEW INCORPORATIONS.

THE CHAMBERS CREEK POWER COMPANY, Tacoma, Wash., has been formed with a capital stock of $250,000. The incorporators are T. O. Abbott and Robert G. Walker.

THE NEW YORK & ORANGE RAILROAD COMPANY has filed articles of incorporation at Trenton, N. J. The company will construct a short railway in Union County. Capital stock, $100,000.

THE DAVID BURNHAM ELECTRIC COMPANY has been incorporated at Portland, Me., with a capital stock of $300,000. The incorporators are P. A. Dowd, of Boston; W. G. Burnham, Boston.

THE FLUSHING GAS & ELECTRIC LIGHT COMPANY, Flushing, L. I., has been incorporated by Charles Whitehead, Fred. J. Witt and B. Franklin DeFreece. Capital stock, $300,000.

THE VALE ELECTRIC LIGHT COMPANY, Vale, Ore., has been incorporated with a capital stock of $2000. Those interested in the enterprise are James N. Fell, M. G. Hope and A. W. Glenn.

THE DARLINGTON ELECTRIC LIGHT & WATER POWER COMPANY, Darlington, Wis., has been organized with a capital stock of $20,000, by Frank S. Walker, T. H. Earle and J. B. Canterbury.

THE CONNEAUT TELEPHONE COMPANY, Conneaut, Ohio, has been incorporated by E. L. Barber, Samuel B. Ramson, James S. Brailey, W. J. Cardie and J. G. Palmer, with a capital stock of $15,000.

THE METROPOLITAN HEAT, LIGHT & POWER COMPANY, of Parsons, Kan., has been incorporated by F. F. Lamb, F. L. Plance, J. H. Galvin, H. W. Davis and L. Brandenburg. Capital stock, $100,000.

THE COMMONWEALTH ELECTRIC LIGHT & POWER COMPANY, Chicago, Ill., has been incorporated with a capital stock of $500,000. The directors are William K. Pattison and Richard W. Robinson.

THE FORT WAYNE LAMP COMPANY, Ft. Wayne, Ind., has been incorporated for the manufacture of electric lamps. The directors are R. T. McMcDonald, Samuel Insull and Henry J. Miller. Capital stock, $100,000.

THE CORMMAN COMPANY, of Cleveland, Ohio, has been incorporated by R. C. Foster, W. A. Carson, J. E. Chinnock, A. E. Burridge and William B. Bolton, for the purpose of dealing in electrical supplies. The capital stock is $10,000.

THE MILFORD, MATAMORAS & NEW YORK RAILROAD COMPANY, Port Jervis, N. Y., has been incorporated to build a road from Matamoras, Pa., to Port Jervis, N. Y. The incorporators are Louis H. Smith, P. C. Deyo and Joseph H. Thompson. Capital stock, $50,000.

THE HARRY C. SPRING SUPPLY COMPANY, St. Louis, Mo., has been incorporated with a capital stock of $5000. Those interested in the new company are Harry C. Spring, Nettie W. Spring and J. S. McLean. The company will do a general plumbing and electrical outfitting business.

THE CLARKE MOTOR COMPANY has been organized at Portland, Me., for the purpose of dealing in and manufacturing electrical machinery and appliances of all kinds. The officers are: President, James W. Briggs, of Boston; treasurer, George A. Clarke, of Boston. Capital stock, $1000.

THE OXFORD & WELCHVILLE ELECTRIC RAILROAD COMPANY, Auburn, Me., has been organized with a capital stock of $25,000. The directors are John B. Robinson, George Hazen, E. F. Richmond, of Oxford; E. W. Eastman, Charles L. Turgeon, George W. McFadden, of Auburn, and Fred. C. Wilson, of Boston.

THE LUNDQUIST AUTOMATIC TELEPHONE COMPANY, Sterling, Kan., has been formed with a capital stock of $100,000. The incorporators are R. J. Shay, W. M. Quigley, George McAllister, J. E. Junkin and M. E. Richardson, of Sterling; Frank A. Lundquist, of Chicago, and John Anderson, of Salina.

THE ONEONTA & OTSEGO VALLEY RAILROAD COMPANY, Oneonta, N. Y., has been incorporated for the purpose of constructing and operating a surface road in Oneonta, and from Oneonta to West Oneonta, a distance of 10 miles. The new company succeeds to all the rights and franchises of the Oneonta Street Railway Company. The directors are Frank Gould, Parker Wilson, A. C. Moody, A. D. Getman, A. C. Lewis, Van B. Pruyn, S. B. Gardner, D. W. Miller and H. H. Getman. The capital stock is $100,000.

THE ELECTRIC RAILWAY.

RIVERHEAD, L. I., N. Y.—The Riverhead, Quogue & Southampton Railroad Company will extend its trolley line to Sag Harbor.

WELLSVILLE, N. Y.—The residents of this place are taking hold of the project to build an electric railway between Wellsville and Dolivar.

NEW BEDFORD, MASS.—A number of prominent citizens of Middleboro and Bridgewater have organized a new electric street railway company to connect the two towns. The capital will be $150,000.

WASHINGTON, D. C.—The County Supervisors met and ordered the construction of the new road from the proposed extension of Prince Street to the Leesburg pike, in accordance with the court order entered last week.

BROOKLYN, N. Y.—The Brooklyn City & Newtown Railroad Company proposes, in a certificate filed with the Secretary of State, the extension of its lines along DeKalb Avenue to the Brooklyn city line, from Wythe Avenue on Rush Street to Broadway.

WASHINGTON, D. C.—The Columbia & Maryland Electric Railroad Company, which is to build a line from Baltimore to this city, has given two mortgages upon its stock and franchises for $3,000,000 each. The funds thus obtained are to be used in building the road.

ELECTRIC LIGHT AND POWER.

LITTLESTOWN, PA.—An electric light company has been organized in this place, and it is expected to have the plant ready by August 1 next. The officers of the new company are J. A. Livers, president; D. B. Alleman, secretary; Henry S. Riley, John A. Shorb and A. Ertter, directors.

WAVERLY, N. Y.—The Waverly Electric Light & Power Company, and the Waverly, Sayre & Athens Traction Company have been consolidated, the latter company having purchased the controlling interest in the business of the former. The object of the consolidation is to improve the service of the electric light company. The light plant will be removed to a lot adjoining the traction company's power house, and the two will be operated together.

PERSONAL NOTES.

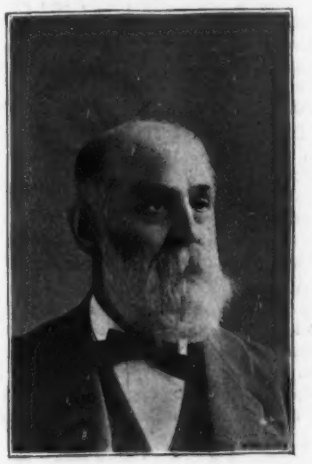
MR. FREDERICK A. BOLAND, civil and mechanical engineer, has opened an office at Hartford, Conn., for the practice of engineering and the solicitation of patents.

MR. EDMUND J. NALLY, superintendent of the Postal Telegraph Company, with headquarters at Chicago, was married at Lexington, Ky., on June 10, to Miss Redd, daughter of County Assessor Redd. The couple will spend their honeymoon in Europe.

MR. C. H. FLORENDEN, of the C & C Electric Company, New York, sailed Saturday, June 19, on the steamer "La Champagne," of the French line, for a pleasure trip, which, among other places, will include Havre, Paris and Marseilles. Mr. Florenden will return to New York the latter part of July.

MR. GEORGE R. STETSON, of New Bedford, Mass., who was elected second vice-president of the National Electric Light Association at the recent Niagara Falls meeting, while one of the older members of the electrical fraternity in point of years, is a comparatively recent acquisition. In 1890 he resigned a position as mechanical engineer to assume the presidency and general management of the New Bedford Gas & Edison Light Company, this corporation being a consolidation of several illuminating interests of that city.

JAMES F. CUMMINGS.



GEORGE R. STETSON.

Under his careful and conservative management, these interests have been regularly and satisfactorily extended. For several years Mr. Stetson has been a member of the Executive Board of the Massachusetts Electric Light Association, and is also a member of the Executive Committee of the Edison Illuminating Companies. During his incumbency of these positions he has had an unusually favorable opportunity to become conversant, not only with the electrical practice of the different systems, but with the relations of the lighting and the power interests to the State and municipalities. He has by no means neglected these opportunities, and has long been an active advocate of the association of those interested in these lines, believing that the best results for all concerned can be secured by active co-operation in both State and national combinations.

MR. JAMES F. CUMMINGS, who is well and favorably known as the inventor of the Cummings conduit and "Armorite," the wood-lined interior conduit tubing, is one of the younger men in the electrical profession. Born in Canada, Mr. Cummings located in Detroit in 1884, and has been continuously engaged in electrical work ever since. When the new interior raceway, known to the trade under the name of "Armorite," first made its appearance, it aroused considerable speculation regarding its merits, but soon won for itself an enviable position. This interior conduit consists of an iron pipe lined with a tube of bass-wood. For a long time Mr. Cummings was engaged in experimenting in the endeavor to produce a machine to manufacture the wooden tube and insert it in the iron pipe. When success finally crowned his efforts the Armorite Company was formed, and its continued prosperity has necessitated its removal to larger quarters at Pittsburg. Mr. Cummings has shown through all his busines career the most indomitable energy, and his tireless and persistent efforts on behalf of his inventions have not only made him personally acquainted with nearly everyone in the electrical business in the United States, but have brought him a large measure of success and prosperity, which is a source of gratification to all who know him. Notwithstanding his active engagements as president of the Armorite Interior Conduit Company, he is still prominently interested in the Cummings Conduit Company, whose headquarters are at Detroit.

Trade and Industrial Notes.

ENGINES FOR RUSSIA.—The Ball Engine Company, Erie, Pa., is building two 125-hp horizontal tandem-compound engines, which will be used for the electric transmission of power and light in a large works in the city of Moscow, Russia.

A NEW AGENCY.—Mr. Wardell Jukes, formerly connected with the United Electric Improvement Company, Philadelphia, Pa., will represent in Philadelphia the Shelby Electric Company, of Shelby, Ohio. He will handle the Shelby Company's incandescent lamps, and his territory will include Philadelphia and vicinity.

STEAM HEATING FROM CENTRAL STATIONS.—The American District Steam Company, Lockport, N. Y., in a pamphlet just issued, describes its system of steam heating from central stations by the Holly system. It gives valuable sugestions regarding the utilization of the waste steam in electric light and power stations.

NEW TELEPHONE CATALOGUE.—The Stromberg-Carlson Telephone Manufacturing Company, Chicago, has issued a neat pamphlet descriptive of its telephone apparatus. Numerous excellent illustrations of the company's instruments and their various applications are presented, together with several testimonials from users of these telephones.

RAW-SILK BICYCLE WIPERS.—The American Silk Manufacturing Company, well and favorably known for its electrical-silk specialties, has just put upon the market a new raw-silk wiper for bicycles. This is put up in small rolls to conveniently fit in the usual tool kit, and it is said by those who have used it to be a most excellent material for keeping the bicycle clean.

ENJOYING A GOOD FOREIGN TRADE.—It is quite rare that wholesale houses located at inland points enjoy much foreign trade, but a notable exception can be found in the Central Electric Company, Chicago, which states that for some time it has had quite a large trade with points in Japan, as well as South America, and quite recently it received a very large order from South Africa, which was secured by submitting quotations in competition with other points.

INCREASED THEIR PLANTS.—The Langhorne Electric Light & Power Company, Langhorne, Pa., has recently increased its electric light plant by adding a 200-hp engine, built by the Ball Engine Company, Erie, Pa., being the third engine of this manufacture placed in this plant. The Wainwright Brewing Company, Pittsburg, Pa., has recently installed an 80-hp engine, built by the same company. The engine is direct-connected to a General Electric dynamo.

ENLARGING THEIR FACILITIES.—Messrs. Johnson & Morton, Utica, N. Y., electrical engineers and contractors, have just completed plans for greatly enlarging the scope of their work. They have installed a very complete equipment of machinery and tools for armature and electrical-machine repair work. They will make a specialty of this work in the future, while continuing to carry on their telephone, electric light and bell-wiring business. They are now prepared to work in any part of the country.

AN IMPROVED ENGINE.—Mr. Fred. F. Fischer, designer of the Fischer, Fischer & Gates and Gates automatic engines, and until recently chief engineer and head salesman of the steam department of the Gates Iron Works, has severed his connection with the Fischer Foundry & Machine Company, Pittsburg, Pa. He will in all probability in the near future place upon the market the improved Fischer engine, which it is intended shall embody the experience gained in designing and operating the above-named engines.

THE HIGHLAND ELECTRIC SOLDERING PASTE is meeting with very great favor as a soldering flux. It seems to possess all of the advantages and none of the disadvantages of other kinds on the market. It is put up in very convenient form for use and makes a very successful joint. The Electric Appliance Company, Chicago, is sending out small sample boxes, and in this way it has secured a sale of several hundred pounds of the soldering paste. Every customer is highly pleased with the work that can be done with this flux.

NEW POWER STATION.—The Berlin Iron Bridge Company, East Berlin, Conn., is erecting a new roof for the power station of the Scranton Illuminating, Heat & Power Company, Scranton, Pa. The building is 42 feet wide and 195 feet long, divided into two portions—a boiler room and an engine room. The framework of the roof construction is of steel and absolutely fireproof. It has been the aim of the Scranton Company to erect a substantial and fireproof building, to replace the one which was recently destroyed by fire.

SATISFACTORY CONDITION OF TRADE.—The Hartley Electrical Works, Chicago, has been making some changes in its office in order to facilitate the handling of its business. For the past two weeks its sales of motors and dynamos have been very satisfactory. The company is doing an excellent business in the repair of electrical apparatus. It also does a large trade in new and used motors, dynamos and transformers. Mr. B. Hartley, the manager, is an old electrical man, having had fourteen years' experience in the business.

THE FLUOROMETER.—This device is a surgical adjunct of X-rays, and is manufactured by the Rochester Fluorometer Company, Rochester, N. Y. The fluorometer is described and illustrated in a little pamphlet just issued by the company. The function of the fluorometer is to establish with precision the location of any foreign body within the human organism, which is permeable or comparatively impermeable to the X-ray. Another of its functions is to provide the surgeon with absolute and reliable measurements in cases of dislocation, fractures, etc.

THE RAINBOW AS A TRADE-MARK.—The rainbow, in all its glory of color, is the most prominent visible feature of the little folder just issued by the Peerless Rubber Manufacturing Company, New York. This company makes the well-known Rainbow packing, which makes steam joints instantly. Other products of this concern are the Eclipse sectional rainbow gasket, the Hercules combination metallic stop-valve packing, the Peerless spiral piston and valve-rod packing and the "Honest John" hydraulic rainbow core packing. All steam engineers will be interested in securing a copy of this circular.

AN ARTISTIC CATALOGUE.—The many excellent productions of the General Incandescent Arc Light Company, 572 First Avenue, New York, some of which are in almost universal use, are most artistically brought to the attention of intending purchasers in the new catalogue recently issued by the company. The various new arc lamps, switchboards, switch devices, conduits, appliances, etc., are all illustrated with a great exactness of detail, and a description which is unsurpassed for clearness. Unquestionably the artistic finish of the catalogue is fully merited by the value of the many appliances described.

THE CHICAGO BELTING COMPANY.—Owing to the typographical appearance of the advertisement of the Chicago Belting Company, 67 South Canal Street, Chicago, Ill., in the recent convention issues of The Electrical World, some of our readers may have gained an erroneous impression that the company was in the hands of receivers. We beg to inform the trade that no such condition exists, and that far from needing the services of receivers, the company's affairs are in a very prosperous condition. It has recently received some gratifying orders, and, as in years past, it continues to carry on a large and profitable business.

A LARGE AND COMPLETE CATALOGUE.—The Western Electric Company, Chicago and New York, has just issued a very complete catalogue of electric light supplies, which consists of 526 pages, and is wholly devoted to all the requirements of central stations. Every known device of practical use in the electric light business is found listed and fully described in this catalogue. One of the features which will be appreciated by the user is the complete index which enables a person to find any article with great ease. The material in the catalogue is classified and divided under eighteen headings. The headings and items are indexed separately. No central station or electric light plant is complete without a copy of this catalogue on file. Copies will be sent upon application.

A PHENOMENAL ELEVATOR CONTRACT.—When some time ago Mr. Frank J. Sprague left for England, there were many rumors afloat regarding his actual mission. As usual, however, Mr. Sprague worked quietly until success crowned his efforts, and he sailed for New York, Wednesday, June 16, justly proud of having obtained the largest contract for elevators of any kind ever awarded. It includes forty-nine electric passenger elevators of very large size, and averaging about 70-feet lift, to be used at the stations of the Central London Underground Railway. All these machines will be of the well-known Sprague type, and will probably include bore, worm and screw constructions. The contract was only awarded after the closest investigation and competition between the Sprague machines and the best machines of other makes. It is therefore most pleasing to all who place their belief in the ultimate success of the electric elevator that this order, involving nearly half a million of dollars, should have been placed for such machines, the product of American brains and skill. Mr. Sprague returns not only eager to fulfill this most recent contract, but also to at once put in execution his plans for the equipment of the Chicago Alley Elevated Railway, which, according to the contract awarded to Mr. Sprague just before sailing to Europe, requires that one train should be electrically operated by the middle of July. The extraordinary energy and push for which Mr. Sprague is famous will undoubtedly serve him well in this instance, and the ultimate success of both ventures is, in fact, already assured.

STEAM TRAPS.—We are advised that the United Gas Improvement Company, Drexel Building, Philadelphia, have sent another large order for Heintz steam traps this month. Mr. William S. Haines, of 118 South Fourth Street, Philadelphia, is the sole agent for these steam savers in the United States and Canada, and is kept busy filling orders from all parts of the country. In this trap the escape of the water of condensation and the retention of the steam is effected by means of the expansion and contraction of a tube spring with valve head, which is partially filled with a fluid very sensitive to the action of heat. The escape valve is wide open at 197° Fahr., but begins to close as the temperature rises, and is tightly shut at 212°, the temperature of live steam. The fluid in the tube spring is so sensitive that a difference of 1° from 212° is sufficient to change the position of the valve from hermetically tight closed, resisting a pressure of 200 pounds, to an opening which will allow the escape of the condensed water. It is to be particularly noted that the movement of the tube spring is not dependent upon its own resiliency, but upon the expansion and contraction of the contained fluid, thus avoiding the setting, which is inevitable in all purely metallic springs, and rendering the closing of the trap at a certain temperature absolutely reliable. It is said by the users of this compact and effective piece of apparatus that it is most accurate in action and reliable and useful. Mr. Haines has received many testimonial letters from users of this trap, commending its work in the highest terms. Among these we may quote from that of Prof. Edward F. Miller, of the Massachusetts Institute of Technology, who says that during his tests of the trap it has been subjected to pressures varying from 100 to 150 pounds, and has worked perfectly. Again, quoting from a letter from Messrs. Hill & Turner, architects, of 44 and 46 Broadway, New York, they state that they have had the trap in use under pressures varying from 5 pounds to 90 pounds, and that it works satisfactorily between these wide limits. Browning & Brothers, manufacturers of dye stuffs and chemicals, Philadelphia, also add their testimony to the merits of this apparatus. They have had a large trap on the drips on a vacuum pan in their factory, which, since its installation, a period of ten months, has given entire satisfaction. It allows the water of condensation to escape continually, thus preventing any backing up, and, last, but not least, it has been found to work equally well with either exhaust or live steam. The testimony of such well-known firms and individuals as the above is a sufficient guarantee as to the reliability of the Heintz apparatus, although if the scope of this article permitted we could quote from hundreds of other letters from well-known manufacturers, all tending to the same end, namely, that the Heintz trap does what is claimed for it.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 8, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

583,900. ELECTRIC METER; J. Harris, Lynn, Mass. App. filed Nov. 25, 1895. A speed governor for an electric meter, consisting of a rotatable fan connected to a spindle and a source of power, and arranged to turn on the spindle by reason of the force of the air-pressure on the fan-blades as the fan and spindle revolve, the spindle having a movable contact-piece arranged to revolve with the spindle, the fan-blades being arranged to press against the movable contact-piece and operate the same, and to recede therefrom at predetermined speeds in order that the electric circuit may be opened and closed and the speed governed.

583,902. RAIL BOND; S. H. Harrington, New York, N. Y., and G. E. Somers, Bridgeport,, Conn. App. filed March 19, 1897. In combination, a rail bond having a shoulder near its end and a separate sleeve adapted to slip over said end and to bear against said shoulder, one end of said sleeve being diagonal of its axis.

583,903. FEED WIRE CONNECTION; S. H. Harrington, New York, N. Y., and G. E. Somers, Bridgeport, Conn. App. filed April 8, 1897. A connector for underground trolleys and the like, consisting of a plug or ferrule adapted to be secured in a rail and a plurality of flattened wires adapted to engage with a feed wire or cable.

583,912. SECONDARY OR STORAGE BATTERY; A. S. Krotz, Springfield, Ohio. App. filed March 27, 1894. In a secondary battery a series of supporting plates formed of insulating material and having slotted openings with upturned edges, and electrodes formed of active material arranged between the said upturned edges and between the said slotted openings, said plates being arranged one above the other with the slotted openings in one plate in line with the electrodes of the adjacent plates.

583,916. SEARCHLIGHT MOUNT; F. T. & G. E. Marchand, Annapolis, Md. App. filed Sept. 21, 1896. A searchlight mount, consisting of a column revoluble about its vertical axis, a stationary base supporting said column, a platform surmounting said column and capable of angular displacement around a horizontal axis, means for displacing said platform around said axis, and a gyroscope controlling said means.

583,926. CONDUIT; J. T. McRoy, Chicago, Ill. App. filed March 22, 1897. In an underground conduit, the combination with a series of sections lain end to end, and each provided with a plurality of longitudinal ducts and dowel-openings formed in the ends of the intersecting partition walls of said ducts, of metallic dowel-pins arranged in the dowel-openings at the adjacent ends of said sections, and collars arranged on said dowel-pins between the ends of the latter.

583,933. ELECTRIC MOTOR; E. S. Pillsbury, St. Louis, Mo. App. filed Nov. 16, 1895. In a motor, the combination with the field magnets of a progressively wound armature, a commutator therefor, a closed winding on the armature, means for short-circuiting the progressive windings of the commutator, and a switch in the motor circuit which is operated by said means.

583,934. SHUNT AMMETER; W. P. Potter, Schenectady, N. Y. App. filed Jan. 25, 1897. A plurality of ammeters connected in shunt to a common resistance.

583,935. SERIES PARALLEI CONTROLLER; W. P. Potter & F. E. Case, Schenectady, N. Y. App. filed Oct. 10, 1896. In a controller, the combination of a cylindrical switch, contacts thereon, and sets of stationary brushes engaging therewith, the brushes and contacts bearing such a relation to each other that the circuit is alternately completed or broken at one set, then at another.

583,938. PNEUMATIC CONTROLLER; E. D. Priest, Schenectady, N. Y. App. filed Sept. 18, 1896. In a controller, a plurality of separate pneumatically operated contacts for varying the resistance of the motor-circuits.

583,939. PNEUMATICALLY ACTUATED CONTROLLER; E. D. Priest and F. A. Merrick, Schenectady, N. Y. App. filed Sept. 28, 1896. In a controller, the combination of a valve, means for operating the valve, and contacts controlled by the valve for establishing various motor combinations, the relation of the valve and operating mechanism being such that the first time the operating mechanism is brought to a predetermined position, one relation of the motors is established, and the next time a different relation.

583,944. ROTARY CONVERTER; E. W. Rice, Jr., Schenectady, N. Y. App. filed March 14, 1896. An armature for dynamo electric apparatus of the alternating-current type comprising a winding and collecting ring, each collecting ring connected to leads equally spaced around the armature-winding and connecting equipotential points of each phase to one of the collecting-rings.

583,945. ELECTRIC LIGHT FOR VEHICLES; A. M. Rodriguez, Brooklyn, N. Y. App. filed Oct. 7, 1896. The combination with a wheeled vehicle and an electric lamp and generator mounted thereon, of a friction-wheel rotatively mounted on the vehicle and in peripheral contact with some part of the wheel thereof, and a flexible shaft between the shaft of said wheel and the arbor of the armature of the generator, and connecting the same, whereby the former drives the latter.

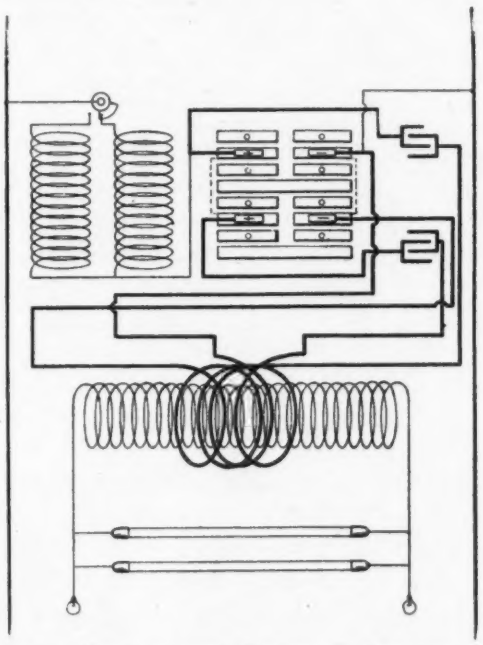
583,950. THREE-PHASE INDUCTION METER; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 30, 1897. A three-phase induction wattmeter, comprising a closed-circuit armature and magnetizing coils comprising current-coils in two of the main lines, and two potential coils or sets of coils in circuit with E. M. Fs., which are in quadrature with the E. M. Fs. between the third and the two main carrying current-coils.

583,953. APPARATUS FOR PRODUCING CURRENTS OF HIGH FREQUENCY; N. Tesla, New York, N. Y. App. filed Oct. 19, 1896. The combination with a set of contacts, one of which is adapted for connection with one of the mains from a source of current, and each of which is connected to one of the terminals of a series of condensers, and a second set of contacts similarly connected to the opposite main and condenser terminals, respectively, of electrically connected plates or segments upon which the contacts of the first set bear, similarly connected plates upon which the contacts of the second set bear, and isolated plates common to the two sets of contacts, whereby the condensers will be alternately charged in multiple and discharged in series.

583,955. CARBON HOLDER FOR ARC LAMPS; E. Thomson, Swampscott, Mass. App. filed Oct. 31, 1896. A carbon clamp for arc lamps, provided with an eccentrically pivoted rotary jaw fixable in a number of working positions, a horizontal sliding jaw, and means for clamping the same in a desired position.

583,956. PRODUCING STEREOSCOPIC PICTURES BY RÖNTGEN RAYS; E. Thomson, Swampscott, Mass. App. filed Jan. 5, 1897. The art of producing stereoscopic pictures by the use of Röntgen rays, which consists in exposing the object to be photographed to a source of Röntgen rays in one position, and then shifting the relative position of the source of rays and the object, while making a second exposure.

583,957. ELECTROSTATIC INFLUENCE MACHINE; E. Thomson, Swampscott, Mass. App. filed Jan. 5, 1897. In an electrostatic generator, a charging exciter-plate provided with an equalizer and a pair of sector charging collectors connected to the sectors of the charging plate and the sectors of the working plates of the machine, the exciter having no connection with the working circuit.



No. 583,953.—APPARATUS FOR PRODUCING CURRENTS OF HIGH FREQUENCY

583,959. SAFETY LAMP; W. Waegel, Philadelphia, Pa. App. filed Sept. 5, 1896. A compression box having flexible heads, means in said compression-box for forcing the flexible heads apart and limiting their compression, consisting of a plug formed in two sections, one having a socket and the other having a shank to fit said socket, and a spring located between the sections of the plug.

583,963. ELECTRIC SWITCH; G. Winckler, Schenectady, N. Y. App. filed June 4, 1896. In an electric switch the combination of a base, a blade for closing the circuit between the terminals, a back or lever to which the blade is removably secured, and a handle for securing the blade to the back and operating the switch.

583,987. LIGHTNING ARRESTER; A. Ekstrom, Schenectady, N. Y. App. filed May 15, 1896. A lightning arrester, comprising a number of spark-gaps in series, of a kind to have their resistance decreased by use, combined with means controlled by such decrease in resistance for increasing the number of spark-gaps in series.

583,997. TURN-TABLE FOR SURFACE-CONTACT ELECTRIC RAILWAYS; E. M. Hewlett, Schenectady, N. Y. App. filed Nov. 18, 1896. In a surface-contact electric railway, sectional conductors in the roadway, a turn-table, studs upon the turn-table, contacts above and below the turn-table, and switches in circuit with the conductors and contacts, whereby by the operation of the turn-table the invariable relation of the contacts on the turn-table and in the railway is preserved.

584,029. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Brooklyn, N. Y. App. filed Nov. 13, 1895. The combination of bus-bars, a feeder, a generator whose field-magnets are provided with a winding

that may be used as a shunt winding, and means for connecting said generator at pleasure either across the bus-bars as a constant-potential machine, or in series between the terminal of said feeder and the bus-bar of like polarity, and means for restoring the feeder to direct connection with the said bus-bar, when the generator is connected across the bus-bars.

584,056. IGNITING DEVICE; B. Jolles, Vienna, Austria-Hungary. App. filed Feb. 1, 1897. In a device for lighting the gas of gas burners, the combination with a casing, a plate or support within the casing, a valve stem working through said plate having a notch near its upper end and formed at its lower end as a conical valve, an electromagnet secured to the under side of the plate or support, an armature carried by the valve-stem for operating the valve, a pawl pivotally mounted on the upper side of the plate or support, for engaging the notch or recess in the valve-stem to hold it in open position, a spring for pressing the pawl forward into the path of the valve-stem, an electromagnet also carried by the plate, an armature carried by or forming part of the pawl, whereby the pawl may be attached and the valve stem released.

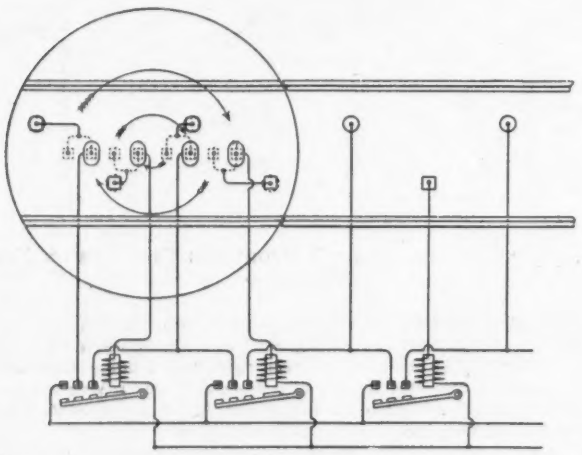
584,062. SYNCHRONIZING MECHANISM; H. F. Parshall, London, England. App. filed Dec. 31, 1895. The art of maintaining synchronism of alternating generators separately operated in parallel, which consists in controlling the speeds of the different generators by means acting upon their prime movers and actuated by the variations of phase relation between the generators.

584,120. ART OF WELDING AND BRAZING; D. W. Payne and E. Diven, Elmira, N. Y. App. filed Oct. 26, 1896. The method of welding or brazing together flatwise metal pieces having different characteristics, which consists in holding the pieces together at the seam or joint, and concentrating heat from two external heat sources upon the metals at opposite sides of the joint, the relative thermal intensities at the points of concentration being so proportioned that the metals of the parts shall be brought to their respective welding or brazing temperature at approximately the same time.

584,128. SYNCHRONIZING CLOCK; J. H. Gerry, Brooklyn, N. Y. App. filed March 11, 1896. In a synchronizing clock, the combination of a clock-train including an escapement in permanent connection therewith, a seconds-hand, an arbor carrying said seconds-hand, and having escapement mounted thereon with freedom of rotary movement, a sleeve mounted on and engaging with said armor so as to be free to slide thereon, but compelled to rotate therewith, a collar fastened on said arbor, a clutch having one member on said escapement, and the other member on said sleeve and collar holding the two parts of the clutch in engagement, synchronizing devices operating on the seconds-hand arbor, and means connected to and operating in conjunction with said synchronizing devices for moving the aforesaid sleeve along the shaft toward said collar to disconnect the clutch.

584,149. AUTOMATIC ELECTRIC TIME SWITCH; L. H. Watters, Media, Pa. App. filed April 1, 1896. In an automatic-time switch, a rotating disc having a shaft, a ratchet wheel attached to said shaft, a minute-hand with post having a cam thereon, and a lever worked by said cam and operating said ratchet-wheel.

584,155. ELECTRIC REGULATOR; C. C. Gartland, Buffalo, N. Y. App. filed Sept. 4, 1896. In an electric regulator for dynamo electric machines the combination of a rheostat, a connecting arm arranged to vary the



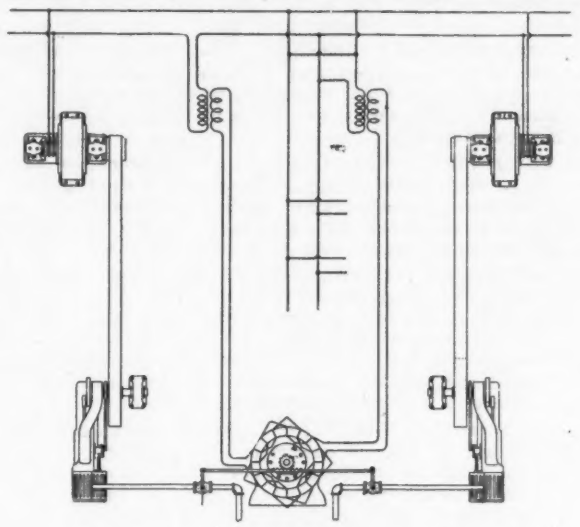
No. 583,997.—Turntable for Surface Contact Electric Railways.

resistance thereof, an arm connected to the brush-rocker of the dynamo, ratchets actuating said arms, oppositely acting pawls adapted to engage said ratchets and move the same in either direction, a rocking lever engaging said pawls and adapted to move the same in or out of engagement with said ratchet, and an electromagnet having its armature connected to one arm of said lever.

584,173. HOTEL ELECTRIC CALL APPARATUS; A. B. Chance, Centralia, Mo. App. filed Nov. 23, 1896. In a hotel electric call apparatus the combination with the clock, the dial having an annulus provided with holes, and the hour hand provided with a spring contact, the wire electrically connected with the hub of the hour-hand and the battery connected with said wire, of pins seated in said holes, wires connected therewith, a cabinet, time-pins, flexible conductors having rings adapted to engage with said time-pins, binding posts with which said rings are connected, annunciators electrically connected with said binding-posts, hinged arms having annunciator plates, hinged armatures, helices, wires wound around the same and connected with a wire connected with a battery and with the terminal of a series of push buttons, and the wire connecting the other terminal of said push-buttons with said binding-posts.

584,184. ELECTRIC ARC LAMP; G. L. Moyer, Hartford, Conn. App. filed Oct. 22, 1896. In an arc lamp, in combination, a magnet connected with the circuit-wires, an armature for the magnet, a piston connected with the armature and movable in a cylinder, a clutch connected with the armature and adapted to engage with and move the upper carbon-rod, and a piston connected with the clutch and movable in a cylinder.

584,185. CUT-OUT SWITCH; G. L. Moyer, Hartford, Conn. App. filed Nov. 18, 1896. In an electric switch, in combination, an insulating base bearing stationary and movable poles, a handle adapted to operate the movable poles, contacts mounted adjacent to each other on the base and connected with the stationary poles, a cap with a chamber for receiving the stationary and movable poles fitted on the base, contacts mounted adjacent to each



No. 584,062.—Synchronizing Mechanism.

other upon the cap and engaging with the contacts on the base, and fuse wire connecting the contacts on the cap and located in a groove separated by insulating material from the chamber that receives the stationary and movable poles.

584,186. ELECTRIC ARC LAMP; G. L. Moyer, Hartford, Conn. App. filed Jan. 20, 1897. In an arc lamp, in combination with the arc-striking mechanism, a feed-clutch, a feed-tube engaging by the clutch, and a feed-rod connected at one end with the feed-tube and at the opposite end with a carbon holder.

584,202. BURGLAR ALARM SYSTEM; W. T. Arnold, Chicago, Ill. App. filed Dec. 15, 1896. In a burglar alarm system, the combination with protecting-conductors, of line conductors leading thereto and therefrom, alarm apparatus included or adapted to be included in circuit therewith, an extraneous resistance interposed between conductors, other conductors which are interwoven or interwound and which surround the conductors leading from the first said conductors to the extraneous resistance and the line conductors, the second said conductors forming continuations or parts of the line conductors.

584,235. INSULATOR FOR TELEGRAPH OR OTHER ELECTRIC WIRES; C. C. Nesmith and G. F. Arnett, Manchester, Ala. App. filed March 27, 1896. In an insulator for electric wires consisting of two separate parts, their contacting faces having one or more curves, and the convex face of one of the separable parts having a half-round groove, the ends of which disappear before passing off the convex portion, and the concave portion being concloidal, a bracket having a recess to receive said insulator and provided with a channel intersecting said recess, and a set-screw entering said recess to bear against one of said parts of the insulator and force it against the other part.

584,249. THERMOSTAT; H. Van Hoevenbergh, NewYork, N. Y. App. filed Jan. 16, 1895. A thermostat comprising a slender metallic rod or wire extending through a non-conducting casing closely embracing it, said conductor being fixed at one end and co-operating with a detent at the other, means for closing an electric circuit through the wire to expand the wire and thereby exert a positive thrust against the detent and a circuit-closer controlled by the detent.

584,297. NON-INTERFERING SIGNAL BOX; J. T. Stack, Chicago, Ill. App. filed Sept. 29, 1890. In a signaling apparatus, a number wheel and a second wheel controlling a short circuit around the said number wheel, the said second wheel being provided with notches which correspond in number and arrangement to the signaling elements of the said number wheel, in combination with a lever having a pin or projection adapted to move in one direction through the said notches, but which cannot normally move through the same in the reverse direction, and a catch or guide which forces the said pin through in the reverse direction at a predetermined point in the wheel's revolution, thus breaking the short circuit, and an extra notch into which the said pin can pass, but not far enough to restore the short circuit.

584,299. CONNECTION FOR ELECTRICAL CONDUCTORS; B. F. Weldon, Pittsburg, Pa. App. filed May 5, 1897. A connection for electrical conductors, or wires, comprising an inclosing envelope, surrounding the wires, and bent transversely.